INSTALLATION RESTORATION PROGRAM

PRELIMINARY ASSESSMENT

192nd Tactical Fighter Group
Virginia Air National Guard

Richmond International Airport

Sandston, Virginia

FEBRUARY 1989

AIR NATIONAL GUARD

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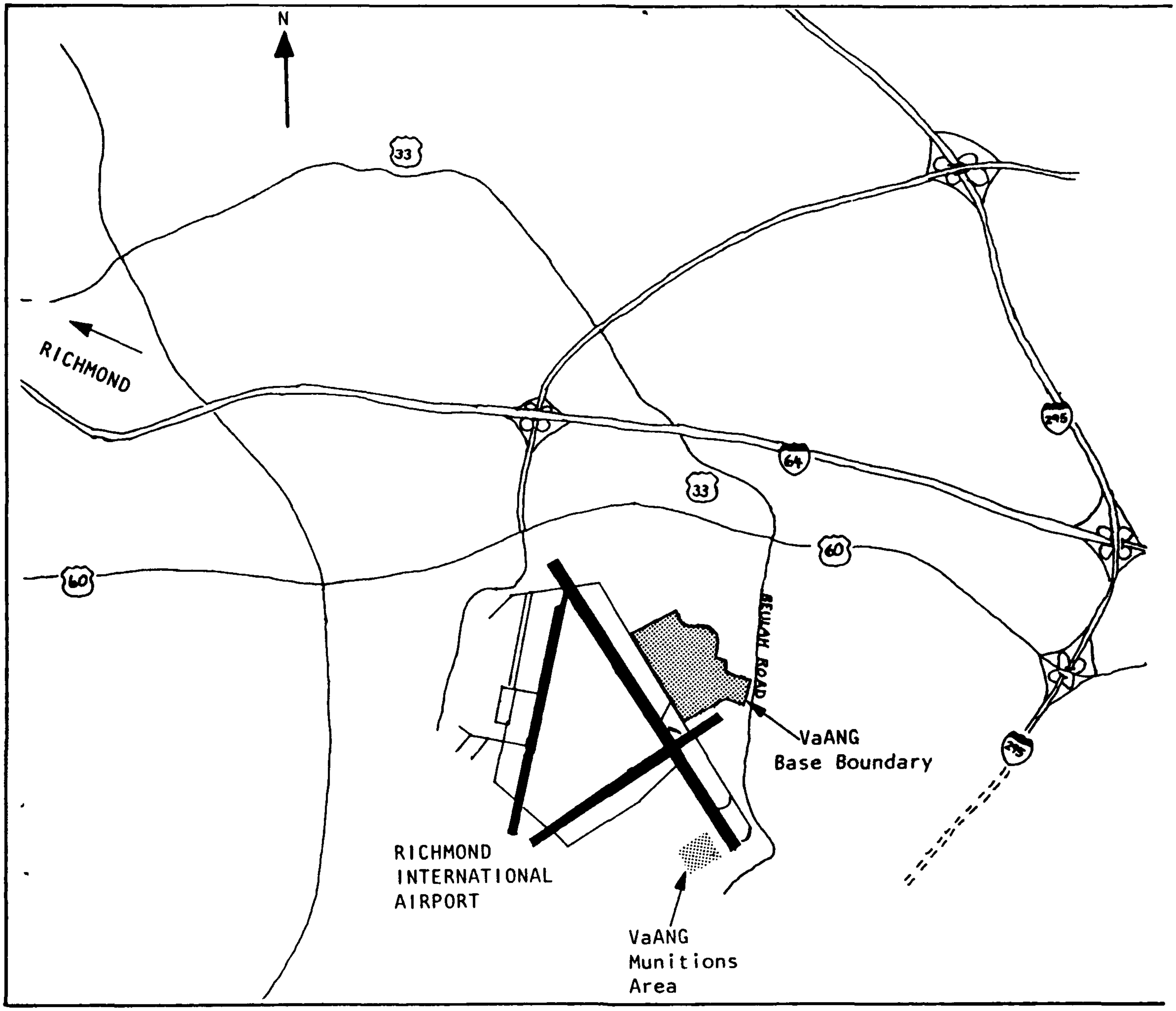

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PRELIMINARY ASSESSMENT

192ND TACTICAL FIGHTER GROUP
VIRGINIA AIR NATIONAL GUARD
RICHMOND INTERNATIONAL AIRPORT
SANDSTON, VIRGINIA

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Prepared for

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ACRONYM LIST

IG	Air National Guard
IGB	Air National Guard Base
IGSC	Air National Guard Support Center
ERCLA	Comprehensive Environmental Response, Compensation and Liability Act of 1980, also called "Superfund"
)D	U.S. Department of Defense
)E	U.S. Department of Energy
RMO	Defense Reutilization & Marketing Office
?A	U.S. Environmental Protection Agency
ARM	U.S. Air Force Hazard Assessment Rating Methodology
AS	Hazard Assessment Score
RS	Hazard Ranking System
RP	Installation Restoration Program
GB	U.S. National Guard Bureau
SAF OEHL	Air Force Occupational and Environmental Health Laboratory
A	Preliminary Assessment
OL	Petroleum, Oil, and Lubricant
CRA	Resource Conservation and Recovery Act
CS	Soil Conservation Service
SAF	U.S. Air Force
SDA	U.S. Department of Agriculture
SGS	U.S. Geological Survey
ST	Underground Storage Tank
aANG	Virginia Air National Guard

EXECUTIVE SUMMARY

A. INTRODUCTION

Science & Technology, Inc. (SciTek) was retained to conduct the Installation Restoration Program (IRP) Preliminary Assessment (Phase I - Records Search) of the 192nd Tactical Fighter Group (TFG), Virginia Air National Guard, Richmond International Airport, (IAP) (formerly Byrd IAP), Sandston, Virginia (hereinafter referred to as the Base). The Preliminary Assessment (PA) included:

- o an on-site Base visit which included interviews with 23 past and present personnel and field surveys by SciTek representatives during 1-5 February 1988;
- o acquisition and analysis of information and records on past hazardous materials use and waste generation and disposal at the Base;
- o acquisition and analysis of available geologic, hydrologic, meteorologic, and other environmental data from federal, state, and local agencies; and,
- o the identification and assessment of sites on the Base which may have been contaminated by past disposal practices.

Sampling and analysis was not included in the PA.

B. MAJOR FINDINGS

The Air National Guard has utilized hazardous materials and generated small amounts of hazardous wastes in mission oriented operations and maintenance at Richmond IAP since 1947. At the time of the site visit, the Base was classified as a Small Quantity Generator (100-1000 kg/mo) of hazardous wastes under regulations promulgated pursuant to the Resource Conservation and Recovery Act.

Operations that have used and disposed of hazardous materials and hazardous wastes include aircraft maintenance, aerospace ground equipment (AGE) maintenance, vehicle maintenance, and petroleum-oil-lubricant (POL) management and distribution. Varying quantities of waste POL products, paints, thinners, strippers, and solvents have been generated and disposed of by these activities.

Interviews with 23 Base personnel and the field surveys identified 3 potentially contaminated sites resulting from past disposal, storage, and/or spills and leaks at the Base.

A short discussion of the rationales for rating each site and the Hazard Assessment Score (HAS) follows:

Site No. 1 - Hardstands (HAS-59)
Confirmed reports indicate that waste trichloroethylene (TCE) was sprayed around the edges of the hardstands for weed control. It was estimated by Base personnel that approximately 150 to 200 gallons of TCE was disposed at this site from 1966 to 1971. The reports estimate that approximately 30-50 gallons per year were disposed of in this manner from 1966 to 1971.

Site No. 2 Bowser Holding Area (HAS-62)
Visible vegetative stress adjacent to this area and disintegration of the underlying asphalt pad indicate a long-term release of fuels from the bowser holding area has occurred. The volume of JP-4 released was small probably less than 100 gallons. Soils around and within an adjoining drainage swale are stained and have a characteristic petroleum odor. With visible evidence of released contaminants, there is potential for contaminant migration by shallow groundwater.

Site No. 3 - Vehicle Maintenance Waste Storage Area, Building 3646 (HAS-61)
The storage area at Vehicle Maintenance has been in the present location for approximately 15 years. The surficial soil is saturated with what appears to be waste POL. An extensive oil sheen was observed on surface water in the drainage ditch adjacent to this area during the field survey.

Persons utilizing White Oak Swamp approximately 3 miles southeast of the Base boundary for recreational purposes are the most likely receptors of any surface water contamination originating from these sites. The potential for exposure to likely receptors through ground water consumption is mitigated by low groundwater usage in the surrounding area and the proximity of discharge points for shallow groundwater.

C. CONCLUSIONS

It has been concluded through visible on-site contaminant migration and/or easily accessible pathways (surface water and/or groundwater) that a potential for contaminant migration from the identified sites to receptors does exist.

D. **RECOMMENDATIONS**

It is recommended that a further IRP Site Investigation be initiated at each of these sites.

I. INTRODUCTION

A. Background

The 192nd Tactical Fighter Group (TFG) is located at the Virginia Air National Guard Base, Richmond International Airport, Sandston, Virginia. The unit has been active at the Richmond International Airport since 1947, and over the years a variety of military aircraft have been located and serviced there. Both the past and current operations involve the use of hazardous materials and disposal of hazardous wastes.

The Department of Defense (DoD) Installation Restoration Program (IRP) is a comprehensive program designed to:

- o Identify and fully evaluate suspected problems associated with past hazardous waste disposal and/or spill sites on DoD installations; and
- o Control hazards to human health and welfare to the environment that may have resulted from these past practices.

During June 1980, DoD issued a Defense Environmental Quality Program Policy Memorandum (DEQPPM 80-6) requiring identification of past hazardous waste disposal sites on DoD installations. The policy was issued in response to the Resource Conservation and Recovery Act of 1976 (RCRA) and in anticipation of the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA, Public Law 96-510) commonly known as "Superfund". In August of 1981, the President delegated certain authority specified under CERCLA to the Secretary of Defense via Executive Order (EO 12316). As a result of EO 12316, DoD revised the IRP by issuing DEQPPM 81-5, on 11 December 1981, which reissued and amplified all previous directives and memoranda.

Although the DoD IRP and the USEPA Superfund programs were essentially the same, differences in the definition of program phases and lines of authority resulted in some confusion between DoD and State/Federal Regulatory Agencies. These difficulties were rectified via passage of the Superfund Amendments and Reauthorization Act (SARA, PL-99-499) of 1986. On 23 January 1987 Presidential Executive Order EO 12580 was issued. EO 12580 effectively revoked EO 12316 and implemented the changes promulgated by SARA.

The most important changes effected by SARA included the following:

- Section 120 of SARA provides that Federal Facilities, including those in DoD, are subject to all the provisions of CERCLA/SARA concerning site assessment, evaluation under the National Contingency Plan (NCP) [40CFR300], listing on the National Priorities List (NPL), and removal/remedial actions. DoD must therefore comply with all the procedural and substantive requirements (guidelines, rules, regulations, and criteria) promulgated by the USEPA under Superfund authority.

- Section 211 of SARA also provides continuing statutory authority for DoD to conduct its IRP as part of the Defense Environmental Restoration Program (DERP). This was accomplished by adding Chapter 160, Sections 2701-2707 to Title 10 United States Code (10 USC 160).

- SARA also stipulated that terminology used to describe or otherwise identify actions carried out under the IRP shall be substantially the same as the terminology of the regulations and guidelines issued by the USEPA under their Superfund authority.

As a result of SARA, the operational activities of the IRP are currently defined and described as follows:

<u>Preliminary Assessment (PA)</u> - A records search designed to identify and evaluate past disposal and/or spill sites which might pose a potential and/or actual hazard to public health, welfare, or the environment. (Read Section I.B., Purpose).

<u>Site Investigation/Remedial Investigation/Feasibility Study (SI/RI/FS)</u> - The Site Investigation consists of field activities designed to confirm the presence or absence of contamination at the sites identified as a result of the PA. The Remedial Investigation consists of field activities designed to quantify the types and extent of contamination present, including migration pathways.

If applicable, a public health evaluation is performed to analyze the collected data. Field tests are required which may necessitate the installation of monitoring wells or the collection and analysis of water, soil, and/or sediment samples. Careful documentation and quality control procedures, in accordance with CERCLA/SARA guidelines, ensure the validity of data. Hydrogeologic studies are conducted to determine the underlying strata, groundwater flow rates, and direction of contamination migration. The findings from these studies result in the selection of one or more of the following options:

- **No further action** - Investigations do not indicate harmful levels of contamination and do not pose a significant threat to human health or the environment. The site does not warrant further IRP action and a Decision Document (DD) will be prepared to close out the site.

- **Long-term monitoring** - Evaluations do not detect sufficient contamination to justify costly remedial actions. Long-term monitoring may be recommended to detect the possibility of future problems.

- **Feasibility Study** (FS) - Investigations confirm the presence of contamination that may pose a threat to human health and/or the environment, and some form of remedial action is indicated. The Feasibility Study is therefore designed and developed to identify and select the most appropriate remedial action. The FS may include individual sites, groups of sites, or all sites on an installation. Remedial alternatives are chosen according to engineering and cost feasibility, state/federal regulatory requirements, public health effects, and environmental impacts. The end result of the FS is the selection of the most appropriate remedial action by the ANG with concurrence by state and/or federal regulatory agencies.

Remedial Design/Remedial Action (RD/RA) - The RD involves formulation and approval of the engineering designs required to implement the selected remedial action. The RA is the actual implementation of the remedial alternative. It refers to the accomplishment of measures to eliminate the hazard or, at a minimum, reduce it to an acceptable limit. Covering a landfill with an impermeable cap, pumping and

treating contaminated groundwater, installing a new water distribution system, and in situ biodegradation of contaminated soils are examples of remedial measures that might be selected. In some cases, after the remedial actions have been completed, a long-term monitoring system may be installed as a precautionary measure to detect any contaminant migration or to document the efficiency of remediation.

Immediate Action Alternatives - At any point, it may be determined that a former waste disposal site poses an immediate threat to public health or the environment thus necessitating prompt removal of the contaminant. Immediate actions, such as limiting access to the site, capping or removing contaminated soils, and/or providing an alternate water supply, may suffice as effective control measures. Sites requiring immediate removal action maintain IRP status in order to determine the need for additional remedial planning or long-term monitoring. Removal measures or other appropriate remedial actions may be implemented during any phase of an IRP project.

B. **Purpose**

The purpose of this IRP Phase I - Records Search is to identify and evaluate suspected problems associated with past waste handling procedures, disposal sites, and spill sites at the Base.

The potential for migration of hazardous contaminants was evaluated by visiting the Base, reviewing existing environmental data, analyzing Base records concerning the use and generation of hazardous materials, and conducting interviews with present and past Base personnel who had knowledge of handling methods. Pertinent information collected and analyzed as part of the Records Search included the history of the Base; the local geological, hydrological, and meterological conditions that might influence migration of contaminants; and ecological settings that [illegible]te environmentally sensitive conditions.

C. **Scope**

The scope of this Records Search was limited to assessment of potential for contaminant migration at all identified sites at the Base and included:

- an on site visit during 1-5 February, 1[illegible]

- acquisition of records and information on hazardous materials use and waste handling practices;

- acquisition of available geologic, hydrologic, meteorologic, land use and zoning, critical habitat and related data from federal and Virginia State agencies;

- a review and analysis of all information obtained; and,

- preparation of a summary report to include recommendations for further action.

The subcontractor effort was conducted by the following Science & Technology, Inc. (SciTek) personnel: Mr. Randall N. Nesmith, Hydrogeologist, Mr. Jack D. Wheat, Geologist, and Mr. James E. Hunt, Chemical Engineer. Resumes of Search Team members are included in Appendix A. SMSgt James L. Craig, Jr. of the Air National Guard Support Center (ANGSC) is project officer for this Base and participated in the overall assessment during the week of the site visit.

D. **Methodology**

Figure IA depicts a flow chart of the records search methodology.

The Preliminary Assessment began with a site visit to the Base to identify all operations that may have utilized hazardous materials or generated hazardous waste. Past and present materials handling procedures were evaluated. Extensive interviews were conducted to determine those areas where waste materials (hazardous or non-hazardous) were used, spilled, stored, disposed of, or released into the environment.

Records contained in the Base files were collected and reviewed to supplement the information obtained from interviews. Three sites were identified as potentially contaminated. These sites were rated using the Air Force Hazardous Assessment Rating Methodology (HARM).

Detailed geological, hydrogeological, meteorological, and environmental data for the area of study was obtained from the appropriate federal and state agencies as identified in Appendix B.

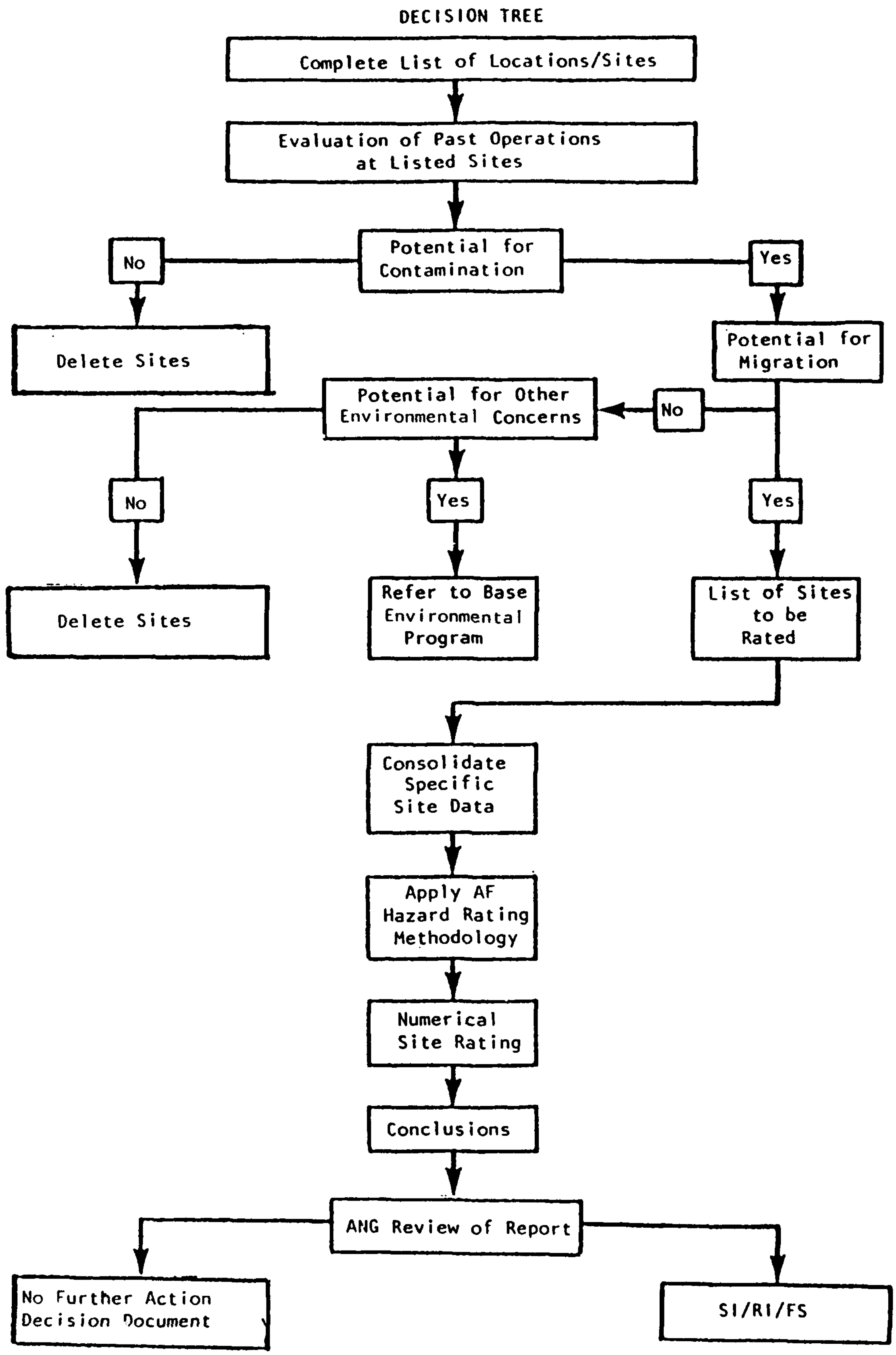


Figure IA. Preliminary Assessment Methodology Flow Chart

After a detailed analysis of all the information obtained, it was decided that three sites are potentially contaminated with hazardous materials/hazardous wastes, and that the potential for contaminant migration exists. Under the IRP program, when sufficient information is available, sites are numerically scored using the Air Force Hazardous Assessment Rating Methodology (HARM). A description of HARM is presented in Appendix C. All three of the sites were scored and each was recommended for further investigation under the IRP.

II. INSTALLATION DESCRIPTION

A. Location

The Base is located within Henrico County, Virginia, four miles southeast of Richmond directly adjacent to Richmond International Airport. Major access routes are interstate highways 64 and 295 and Virginia state highways 60 and 33 (Figure IIA). The Base occupies 143 acres, has an authorized population on drill weekends of 1048 guardsmen and during the week 304 full time employees, and is home to the 192nd "Tactical Fighter Group". Figure IIB presents the location and boundaries of the Base.

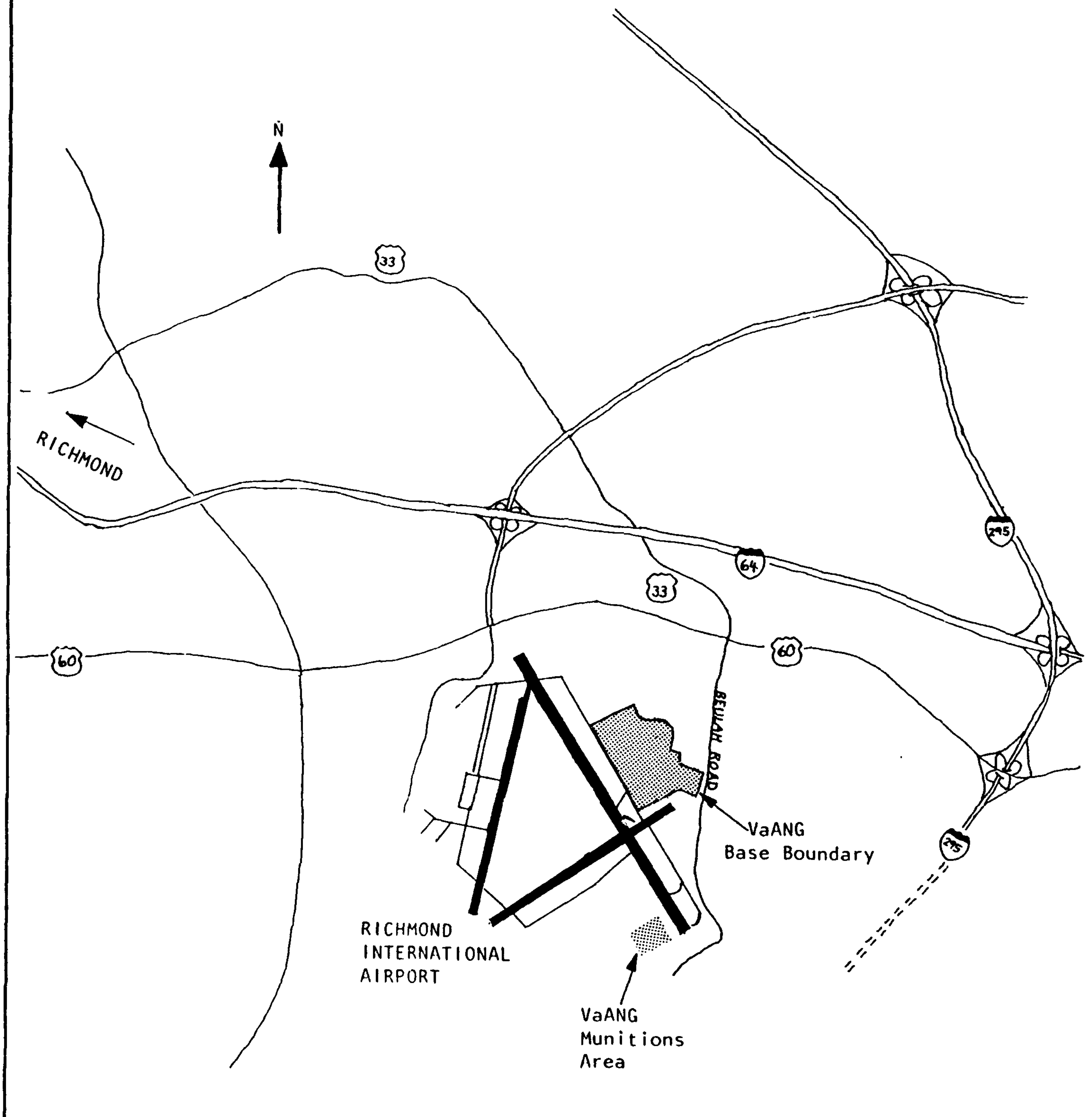
B. Organization and History

The units of the Base as they exist today, can trace their lineage directly back to one of the top Army Air Force fighter units of World War II. This was the 328th Fighter Squadron which was activated on the 1st of October 1942 as a part of the 352nd Fighter Group, flying Republic P-47's, and later, North American P-51's with the Eighth Air Force in England and Belgium.

The 328th Fighter Squadron was deactivated immediately after World War II and was redesignated the 149th Fighter Squadron in May of 1946 when this unit designation was assigned to the Commonwealth of Virginia Air National Guard. In February of 1947 the unit was given authority to locate at Byrd Field and was supplied with the P-47 Thunderbolt fighter which was the same aircraft flown by the original 328th throughout most of World War II. The 149th received federal recognition as an active unit on the 21st of June 1947 with 18 officers and 42 enlisted men.

In March of 1951, the 149th was called to active duty. It was to serve for 21 months during which time many of the unit's personnel were assigned to other outfits in combat in Korea or other overseas areas. The 149th came home to Virginia and Byrd field on 1 December 1952.

The unit was reorganized into the 149th Bombardment Squadron and reequipped with Douglas B-26 Invaders in November of 1953. The B-26's stayed until 1958. On the 14th of June the Base received the Republic F-84F Thunderstreak jets. On November 10 the unit was redesignated as a Tactical Fighter Squadron.



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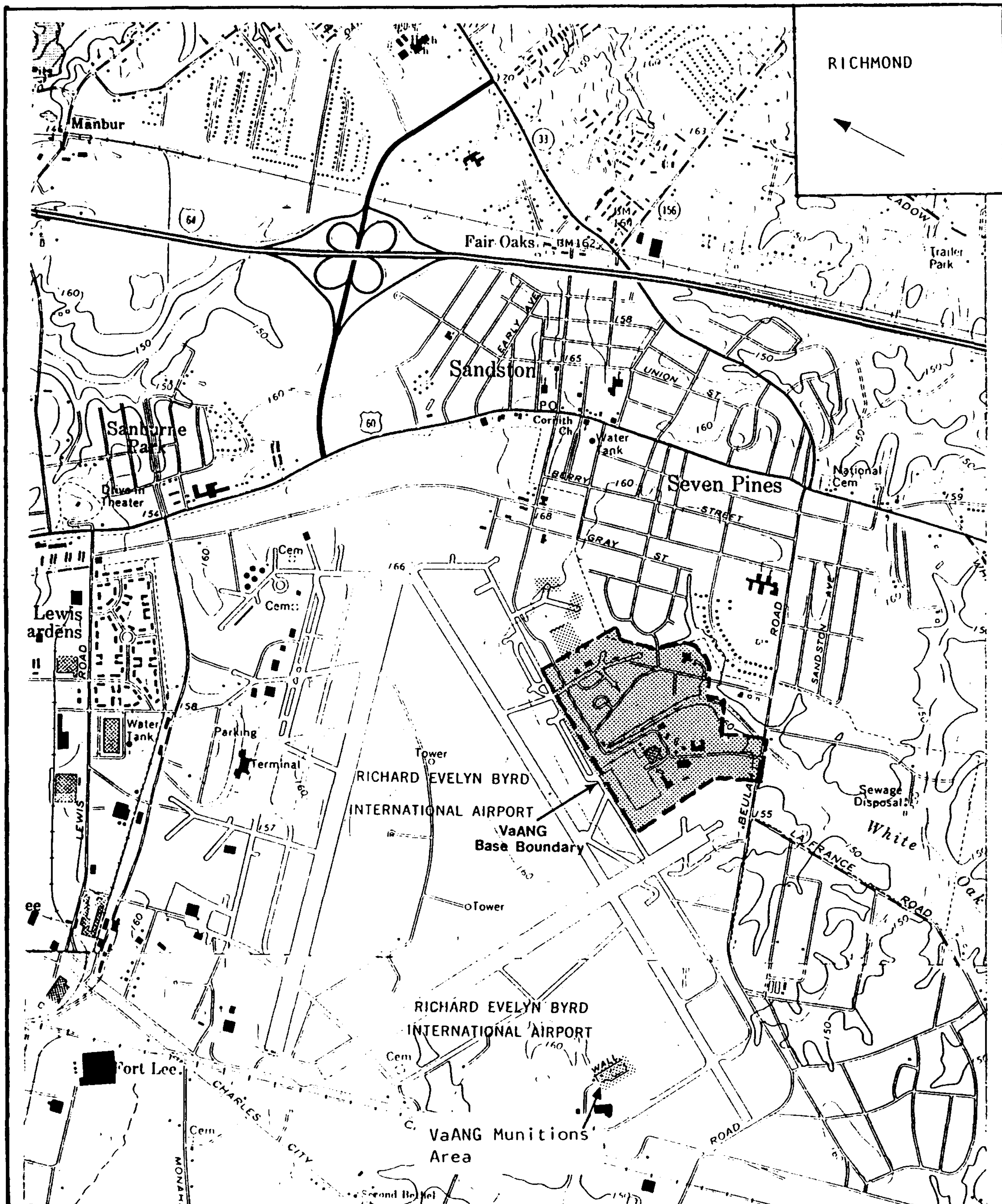
Interstate Highway 64
State Highway 60
VaANG Property

SCALE
1"=4444'

Figure IIA. Major Access Routes
VaANG Base



Source: U.S.G.S. 7.5 Minute Series Dutch Gap and Seven Pines Virginia

SCALE 1"=2000'

N

VaANG Base Property

Figure IIB. Location Map 192 nd Tactical Fighter Group

From October 1961 until August 1962 the unit was again on active duty due to the Berlin crisis. In October 1962 the unit was redesignated as the 192nd Tactical Fighter Group. In January 1971, the 192nd became the first Guard Unit in the country to receive the F-105 Thunderchief jets, a battle-tested Vietnam veteran aircraft nicknamed the "Thud".

The first A-7D Corsair flew into Byrd Field in June 1981. The unit officially began converting from the F-105 system to the A-7 in October of 1981, and on 1 April 1982 the Base was declared operationally ready in the new aircraft.

In order to retain the proper qualifications, the pilots must train considerably more than one weekend a month. They must fly a minimum of six times per month, so the squadron conducts training missions from Byrd five days a week supported by full-time maintenance and other support personnel.

The 192nd TFG consists of 1048 guardsmen authorizations, most of whom train one weekend a month and two weeks each year.

III. ENVIRONMENTAL SETTING

A. Meteorology

The following climatological data was largely derived from the Soil Survey of Henrico County, Virginia, from local weather data and from information supplied by the National Oceanic and Atmospheric Administration.

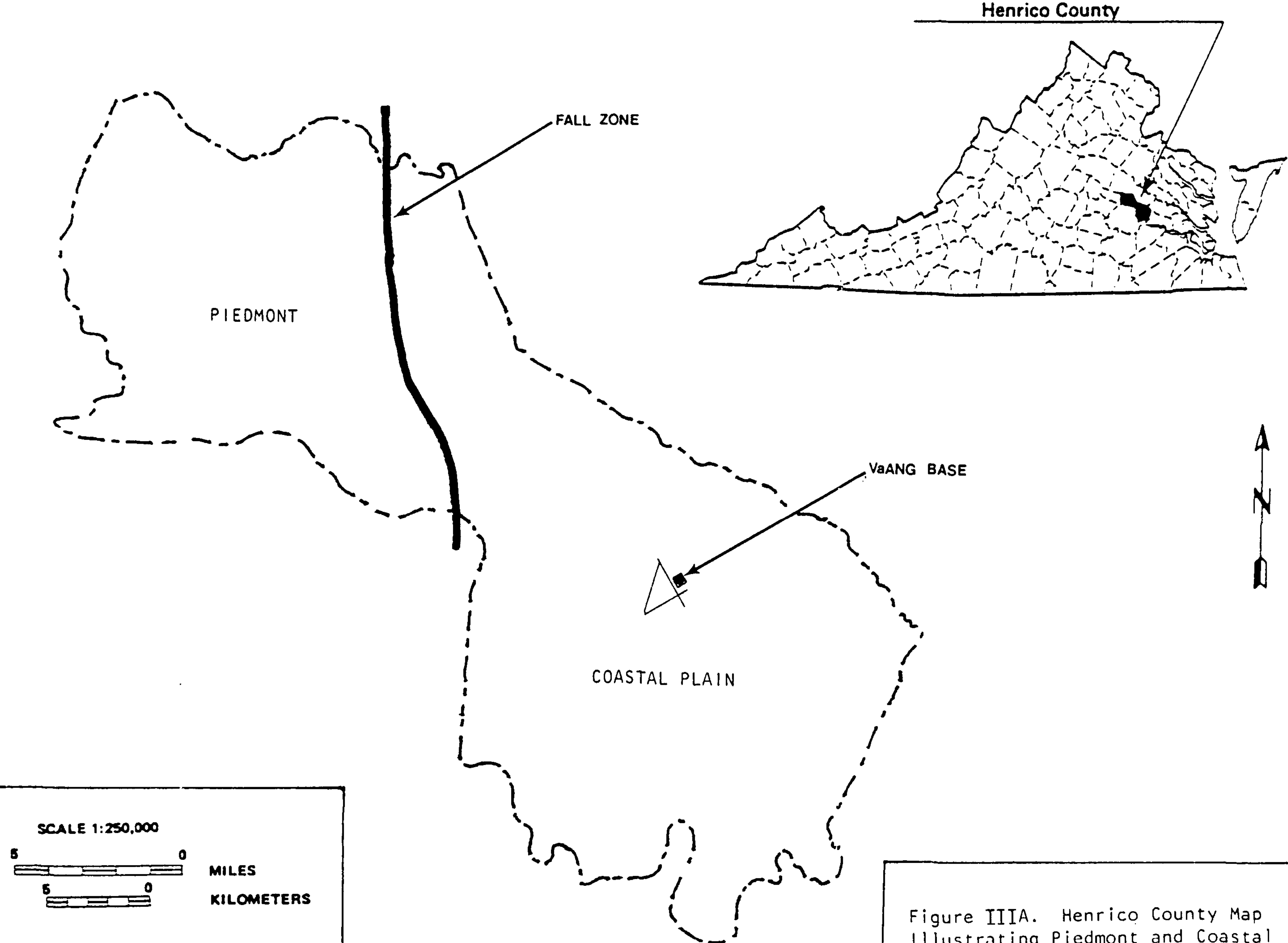
The climate at the Base consists of humid summers and mild winters. Average mean annual temperatures range from 55 to 60^{0}F. Current 1987 climatological data illustrates a seasonal temperature extreme which varies from a winter low of 1^{0}F to a summer high of 101^{0}F.

Precipitation is rather uniformly distributed throughout the year. Dry periods lasting several weeks occur in autumn when long periods of pleasant, mild weather are most common. The total precipitation for 1987 was 33.15 inches. The mean annual precipitation for the past 40 years was 43 inches.

B. Geology

Henrico County, Virginia is subdivided into two regional physiographic provinces. These provinces are the Piedmont and Coastal Plains. The Base is located in the Coastal Plains province. The physiographic boundary of the Piedmont and Coastal Plans is the Fall Zone. The Fall Zone trends North-South through Henrico County dividing the Piedmont Province to the West and the Coastal Plains Province to the East (Figure IIIA). Geographically, the Fall Zone is recognized by changes in stream gradient and topographic transition from gently rolling hills of the Piedmont to poorly drained flatlands of the Coastal Plains. Coastal Plain elevations range from sea level to a maximum topographic elevation of 300 feet.

Outcropping stratigraphy throughout Henrico County varies from Paleozoic and Mesozoic age formations of the Piedmont to younger Cenozoic age unconsolidated sediments of the Coastal Plains. At the Fall Zone outcropping Piedmont formations dip abruptly eastward resulting in an eastward thickening of the overlying Coastal Plains sediments. The Coastal Plain sediments thin westward and pinch-out at the Fall Zone.



Source: Wigglesworth, 1984.

Figure IIIA. Henrico County Map Illustrating Piedmont and Coastal Plains Physiographic Provinces

The Coastal Plain stratigraphy at the Base is a 350 to 400 foot sequence of Marine and Terrestrial unconsolidated sediments. These stratas range in age from more recent Quaternary to lower Cretaceous (Table IIIA). The basement complex, i.e., solid rock formations may, be Triassic age sedimentary rocks or Paleozoic crystalline formations.

Surface stratigraphy at the Base underlying the soil overburden is the Quaternary-Tertiary Yorktown-Eastover formation. Lithologically the Yorktown-Eastover is a combination of marine unconsolidated quartz sands and clays. The Yorktown-Eastover thickness varies from 40 to 50 feet.

The Yorktown-Eastover conformably overlies the Tertiary age Calvert formation. Lithologically the Calvert is a plastic clay. With clay a major constituent in matrix composition, this interval is an aquiclude to groundwater migration. Calvert thickness varies from 25 to 30 feet.

Conformably underlying the Calvert is the Tertiary age Piney Point formation. The Piney Point lithology is a medium grained unconsolidated glauconitic quartz sand. Distinct indurated shell layers of marine organisms have been observed in geologic sample and core analysis by the United States Geological Survey (USGS) personnel. The Piney Point thickness averages 10 feet.

The Piney Point conformably overlies the Tertiary age Nanjemoy formation. The Nanjemoy lithology is a glauconitic quartz unconsolidated marine sand. Geologic sample analysis has observed clay as a major constituent in matrix composition. The Nanjemoy thickness varies from 35 to 40 feet.

Conformably underlying the Nanjemoy is the Tertiary age Marlboro formation. The Marlboro lithology is a plastic clay. This clay is a relatively impermeable aquiclude to groundwater migration. The Marlboro thickness averages 10 feet.

The Marlboro conformably overlies the Tertiary age Aquia formation. The Aquia lithology is composed of fine grained, unconsolidated glauconitic marine quartz sands. The Aquia thickness averages 50 feet.

Conformably underlying the Aquia is the Cretaceous Age Potomac Formation. The Potomac lithology is a combination of unconsolidated quartz sands and interbedded clays. Wentworth Scale grain size varies from coarse gravel

Source: Drawn by J. Wheat.

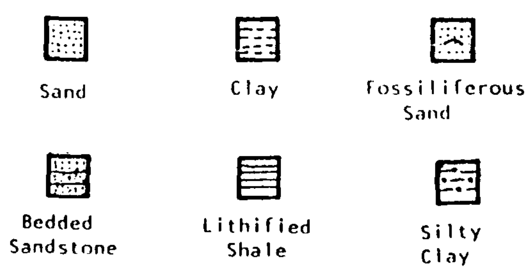
Table IIIA. Columnar Stratigraphic Section For Coastal Plains Unconsolidated Sediments In The Vicinity Of The Virginia Air National Guard Base

AGE	FORMATION	THICKNESS	LITHOLOGY	DEPTH FROM SURFACE	COMMENTS
QUATERNARY	YORKTOWN-EASTOVER	40-45'		10'	Underlies 8-10' of soil overburden Uppermost unconfined aquifer includes soil-watertable aquifer
TERTIARY	CALVERT	25-30		50'	Confining aquiclude separating confined aquifers from soil-watertable aquifer
	PINEY POINT	10'		80'	Chickahomy aquifer
	NANJEMOY	35-40'		90'	
	MARLBORO	10'		130'	Confining aquiclude
	AQUIA	50'		140'	Aquia aquifer
CRETACEOUS	POTOMAC	190-200'		190'	Principal aquifer for groundwater supply; Potomac aquifer encompasses entire Potomac formation
TRIASSIC	BASEMENT			390'	"Basement Complex" Consolidated hard rock formations

VERTICAL SCALE
1"=50'

50'
25'
0

LEGEND



to very fine sand. The Potomac depositional environment is a continental deltaic complex with quartz sand channels and lenses occurring at various stratigraphic intervals. The entire Potomac section adjacent to the Base has an average thickness of 200 feet.

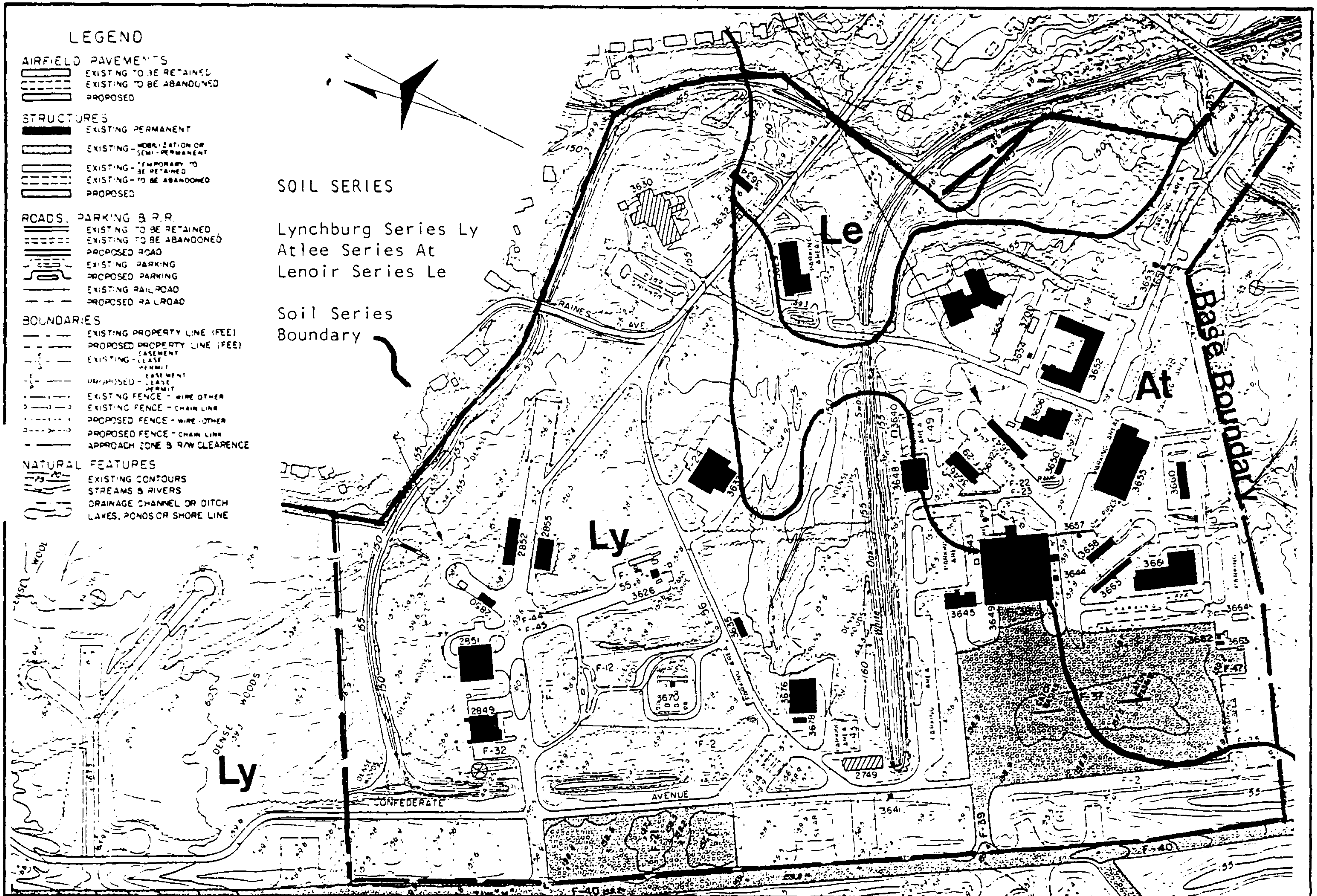
The basement complex, i.e., consolidated hard rock formations, underlie the Cretaceous age Potomac in both a conformable and unconformable depositional relationship. Throughout most of the Coastal Plains geographical region, the basement complex is Paleozoic crystalline formations which cropout in the Piedmont physiographic province. However, within certain areas of the Coastal Plains Province, down faulted grabens which resulted from plate tectonics have created depositional basins. Triassic - Jurassic sediments were unconformably deposited in these graben faulted basins.

Sedimentary Triassic and Jurassic formations are a combination of interbedded sandstone, shale, conglomerate, and coal. USGS personal have concluded from water well data and electric log evaluation that the basement lithology at the Base is Triassic sedimentary rocks deposited in a graben faulted basin.

C. **Soils**

The United States Department of Agriculture (USDA) has mapped three distinct soil series within the boundaries of the Base. These individual series are the Lynchburg Series (Ly), Lenoir Series (Le), and the Atlee Series (At). The areal distribution and location for each soil series is illustrated in Figure IIIB. Each of the three soil series at the Base site are loamy, clay soil types which contain an estimated clay composition ranging from 14-40%. Soil permeability throughout the Base is low to moderate with USDA permeability calculations varying from 0.06 to 2.0 inches/hour. A USDA vertical soil profile for each series illustrating soil type, soil permeability, and soil estimated clay composition is illustrated in Table IIIB.

The depth of the soil watertable at the Base varies from 1 to 15 feet below ground surface. This watertable depth is consistent for each of the previously described soil series. Variations in the soil watertable depth are the result of seasonal precipitation, i.e., rainfall, thunderstorms, snowfall, etc. An increase in precipitation will result in a shallower soil watertable.



Source: VaANG Civil Engineering

(Ref. Clay, 1975)

SCALE
1"=400'

Figure IIIB. Soil Series Distribution Map VaANG Base

TABLE IIIB USDA VERTICAL SOIL PROFILE
FOR SOIL SERIES AT VaANG BASE

SOIL SERIES	SOIL TYPE		SOIL PERMEABILITY		ESTIMATED PERCENT CLAY	
	Depth From Surface	Soil Type	Depth From Surface	Permeability inches/hour	Depth From Surface	Percent Clay
LYNCHBURG (LY)	0-14"	Very Fine Sandy Loam	0-14"	0.6-2.0	4"-14"	14%
	14"-104"	Clay Loam			25"-47"	25%
					47"-104"	30%
ATLEE (AT)	0-22"	Loam and Clay Loam	0-22"	0.6-2.0	4"-12"	15%
	22"-54"	Clay	22"-102"	0.2-0.6	22"-102"	33%
LENOIR (LE)	0-14"	Silt Loam and Silty Clay Loam	0-14"	0.6-2.0	3"-7"	15%
	14"-110"	Clay and Silty Clay	14"-110"	0.06-0.2	15"-100"	40%

(Ref. Clay, 1975)

The removal of soil at the Base by surface erosion is not a major hazard. Gentle topographic slopes of 0.2% prevent the immediate runoff of excess surface water.

D. Hydrology

Surface Water

The Base is located within the James River drainage basin. Surface run-off from the Base is collected by a series of swales and drainage ditches and discharged to White Oak Swamp at the Base's eastern boundary (Figure IIIC). White Oak Creek drains White Oak Swamp to the Chickahominy River which flows to the James River. The Chickahominy-James River confluence is approximately 12 miles south-east of the Base boundary. According to sources at the Henrico County Planning Office, the Base is not located within the 50-year flood plain.

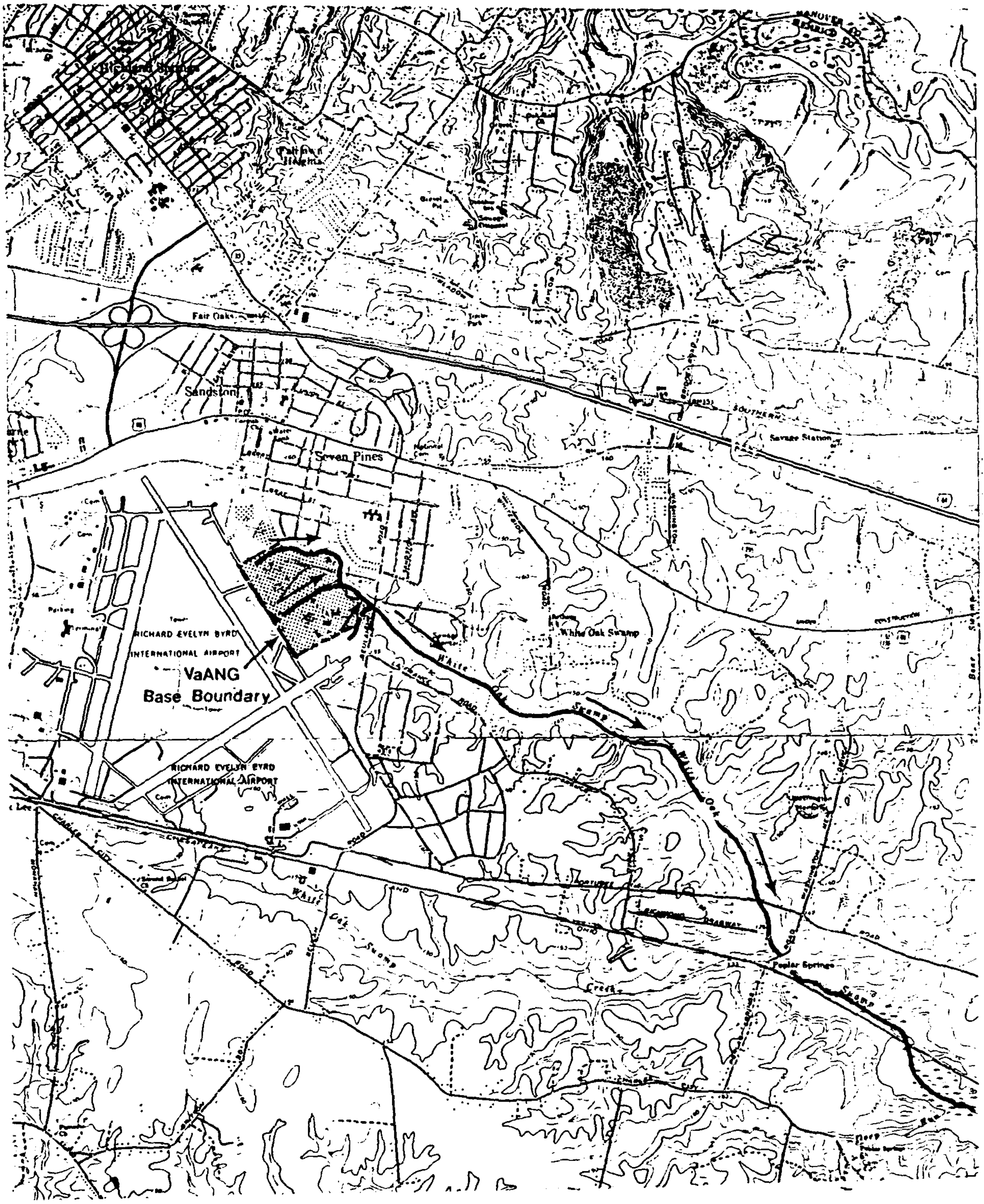
Groundwater

The principal coastal plain aquifers at the Base are the Yorktown, Chickahominy, Aquia, and Potomac. The stratigraphic horizon for each aquifer is illustrated in Table IIIA. The Chickahominy, Aquia, and Potomac are confined or artisan type aquifers. The Yorktown is the uppermost unconfined aquifer.

The Yorktown aquifer occurs within the Tertiary age Yorktown-Eastover Formation. The Yorktown and soil watertable aquifer have been classified by USGS personnel as a single unconfined aquifer. The Yorktown aquifer screened interval for potable water wells ranges from 35 to 45 feet below ground surface.

The next aquifer underlying the Yorktown is the confined Chickahominy. The Chickahominy aquifer occurs within the Tertiary age Piney Point formation. The confining Chickahominy aquicludes are the overlying Calvert clay and the underlying Marlboro clay. Water well data illustrates that the average Chickahominy thickness ranges from 10 to 15 feet. The Chickahominy aquifer screened interval for potable water wells averages 75 feet below ground surface.

Underlying the Chickahominy is the confined Aquia aquifer. The Aquia aquifer occurs within the Tertiary age Aquia formation. The confining aquicludes are the overlying Tertiary age Marlboro clay and the underlying confining clays of the Cretaceous age Potomac formation. The Aquia aquifer



Source: U.S.G.S. 7.5 Minute Series
Seven Pines and Dutch Gap Virginia

N

SCALE
1"=4000'

VaANG Base Property

Figure IIIC. Surface Drainage Map For VaANG Base and Adjacent Vicinity

"LEGEND"

Surface Drainage Route

Direction of Surface Flow

thickness ranges from 50 to 60 feet. The Aquia aquifer screened interval for potable water wells ranges from 120 to 130 feet.

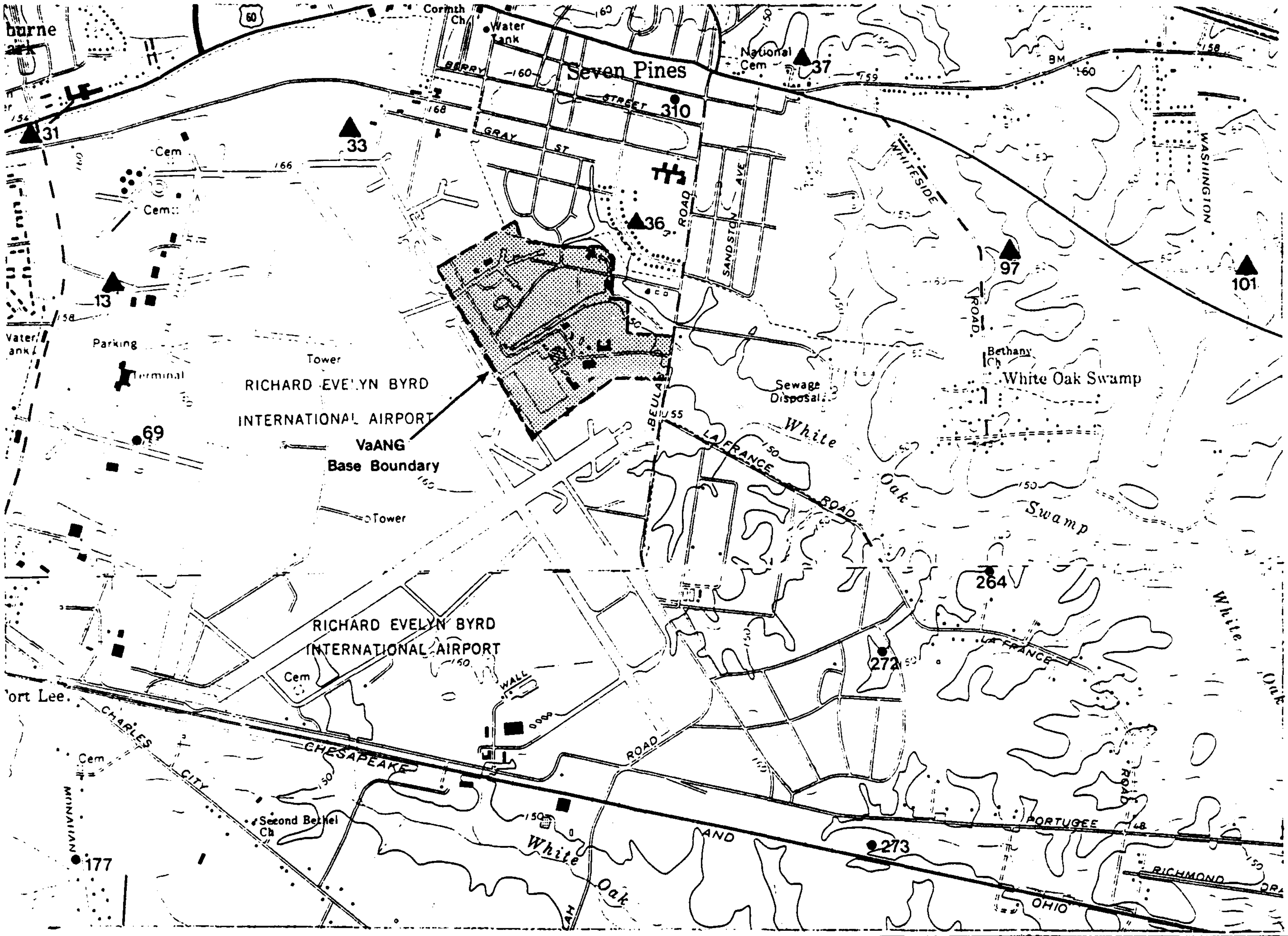
The underlying Potomac aquifer has been classified by USGS personnel to include the entire Potomac formation. Numerous individual confined aquifers occur throughout the entire Potomac section. Potomac aquifers are associated with deltaic stream channels which contain high porosity and permeability. The screened interval for potable water wells surrounding the Base, which produce from the Potomac aquifer, ranges from 225 to 275 feet below ground surface.

The water supply for the Base is municipal water purchased from the Henrico County Department of Public Utilities. Henrico County municipal water is derived from commercial water wells owned by Henrico County and the James River approximately 8 miles south of the Base boundary. The majority of Henrico County commercial water wells produce from the confined Potomac aquifer.

Interviews with numerous Base personnel have concluded that throughout the Base history, i.e., 1947 - present no water wells have been drilled within the Base boundary. However, as illustrated in Figure IIID, numerous water wells have been drilled surrounding the Base perimeter. These water wells are owned by individual private citizens and the Henrico County Department of Public Utilities. Water well #36, the well most adjacent to the Base is located 700 to 800 feet northeast of the VaANG Base boundary (Figure IIID).

The major groundwater source for potable water wells surrounding the Base is the Cretaceous age Potomac aquifer. Evidence supporting this conclusion is a total of 36 potable water wells surrounding the Base in which 19 of these wells produce from the Potomac Aquifer, 11 from the Aquia and Chickahominy, and 6 from the uppermost Yorktown unconfined aquifer. Each of the wells producing from the York town aquifer are further than 3,000 feet from the Base boundary.

The natural recharge for confined aquifers, i.e., Potomac, Aquia, Chickahominy, is the Fall Zone. Lateral down gradient groundwater migration from the Fall Zone eastward replenishes groundwater pumped by private and public utilities. The general confined aquifers groundwater flow is to the east with ultimate discharge in the Atlantic Ocean. The recharge for the unconfined Yorktown aquifer is the vertical migration of percolating surface water. Discharge



Source: U.S.G.S. 7.5 Minute Series
Dutch Gap and Seven Pines Virginia
(Ref. Wigglesworth, 1984)

"LEGEND"
Domestic Water Well ● Virginia State
Municipal Water Well ▲ Water Well No.88

SCALE
1"=2000'

Figure IIID. Potable Water Well Location Map For VaANG Base and Vicinity

for the uppermost unconfined aquifers is the local streams with ultimate destination in the James and Chickahominy River watershed.

The unconfined Yorktown aquifer is the most susceptible to groundwater contamination from surface pollutants. Deeper confined aquifers are protected from the vertical migration of potentially contaminated groundwater by the Calvert clay aquiclude (Figure IIIA). With a seasonal soil watertable variation of 1-15 feet below ground surface, there is a higher risk of contaminated ground water migration with increases in seasonal precipitation. The major risk to receptors from migrating potentially contaminated ground water is the lateral down gradient groundwater movement and discharge into the White Oak Creek watershed. Consumption of contaminated untreated drinking water is not a major risk because, as previously mentioned, the unconfined Yorktown aquifer is not a domestic groundwater source within 3,000 feet of the Base boundary.

E. CRITICAL HABITATS/ENDANGERED OR THREATENED SPECIES

There are no critical habitats either directly adjoining or in the immediate vicinity of the Base. The White Oak Swamp Natural Area four miles southeast of the Base boundary contains wetlands habitat in which there would be an impact upon the local ecosystem from released waste migrating by surface water drainage.

Correspondence with the Commonwealth of Virginia Department of Conservation and Historic Resources Virginia Natural Heritage Program has revealed that there are no occurrences of rare plants, animals, or natural communities either within the boundaries or in the immediate vicinity of the Base. However, there are certain endangered plant species within the White Oak Swamp Natural Area. The following is a list of Virginia Natural Heritage Program White Oak Swamp rare plant species:

Pisilocarya Nitens	Short-Beaked Baldrush
Juncus Caesariensis	New Jersey Rush
Lobelia Elongata	Elongated Lobelia
Chelone Cuthbertii	Cuthbert Turtlehead

IV. **SITE EVALUATION**

A. **Activity Review**

The review of Base records plus personal interviews with present and former Base personnel identified specific operations in which the majority of hazardous materials and/or hazardous wastes were used, stored, processed or disposed. Table IVA summarizes the major operations associated with each activity. If an item is not listed in the table on a best-estimate basis, that activity or operation produces negligible (estimated less than five gallons per year) waste generation requiring disposal.

Table IVB lists the building numbers and building identification for individual installations throughout the VaANG complex. The location of these buildings within the Base complex is illustrated in Figures IVA and IVB.

B. **Disposal/Spill Site Identification, Evaluation, and Hazard Assessment**

Interviews with 23 past and present Base personnel and subsequent site visits identified three spill/waste disposal sites resulting from past Base actions (Figure IVA).

Site No. 1 - Hardstands (HAS-59)

The contaminant source at Site No. 1 is waste trichloroethylene (TCE). Used as an herbicide, this substance was sprayed around the edge of two hardstands (aircraft parking areas). From Base interviewees and records there are confirmed reports that TCE was used as an herbicide at Site No. 1 from 1966 to 1971. An estimated 150 to 250 gallons of TCE was used at a rate of 30 to 50 gallons per year.

The two hardstands were observed to be circular concrete pads approximately 150 to 200 feet in diameter. Visual on-site inspection of the area immediately surrounding the hardstands revealed no stress vegetation or additional visible evidence of contaminant migration.

TABLE IVA. HAZARDOUS MATERIALS/HAZARDOUS WASTE DISPOSAL SUMMARY
VaANG, RICHMOND INTERNATIONAL AIRPORT
SANDSTON, VIRGINIA

Shop	Building No. (Past & Present)	Hazardous Materials/ Hazardous Waste	Estimated Quantities (Gal./Year)	1950	1960	1970	1980	1985	1986	1987	1988
Aircraft Maintenance											
(1) Jet Engine Maintenance	3648	PD-680 (Solvent)	100	UK	FTA	CONTR		DRMO			
		Carbon Cleaner MLK	24	UK	FTA	CONTR		PROC			
(2) Jet Engine Test Cells	3626	Strippers MEK	5	UK	UK	CONTR	DRMO				
		Synthetic Turbine Oil	350	UK	FTA	CONTR		DRMO			
(3) Fuel Systems	2851	JP-4	150	UK	UK	FTA	CONTR	PROC			
(4) Flightline Section	3649	Engine Oil	20	UK	UK	FTA	CONTR	DRMO			
		Cleaning Compound	200-250	___	___	___	CONTR	PROC			
		Safety-Kleen Solvent	120	___	___	___	___	___	CONTR		
Aerospace Ground Equipment Maintenance (AGE)											
(1) Powered AGE	2849	Engine Oil	165	UK	CONTR			DRMO			
(2) Non Powered AGE	3649	Hydraulic Oil	660	UK	UK	CONTR		DRMO			
		PD-680	800	UK	UK	CONTR		DRMO			
		Turbine Oil	65	UK	UK	CONTR		DRMO			
		Battery Acid	20	UK	UK	CONTR		NS			
		Aircraft Cleaning Cmpd.	2	UK	UK	CONTR		EVAP			
		Other Aerosol Paints	12	UK	UK	CONTR		PROC			
		Safety-Kleen Solvent	500	___	___	___	___	___	CONTR		
		Aerosol Primers (ZnCr)	2	UK	UK	CONTR		PROC			
		Epoxy Primers	7	UK	UK	CONTR		PROC			
		Polyurethane Paints	12	UK	UK	CONTR		PROC			
Wheel Shop Stripping Area		Paint Strippers/ Thinners	45-50	UK	UK	CONTR		DRMO			
Corrosion Control	2851	Solvents/PD 680	100	UK	EVAP						
		Thinners	10	UK	EVAP			DRMO			
		Paint Strippers	100	UK	EVAP			DRMO			
		Lacquer	48	UK	EVAP			PROC			

TABLE IVA. HAZARDOUS MATERIALS/HAZARDOUS WASTE DISPOSAL SUMMARY CONTINUED
VaANG, RICHMOND INTERNATIONAL AIRPORT
SANDSTON, VIRGINIA

Shop	Building No. (Past & Present)	Hazardous Materials/ Hazardous Waste	Estimated Quantities (Gal./Year)	1950	1960	1970	1980	1985	1986	1987	1988
Corrosion Control Cont.	2851	Other Degreasers	110	UK				SAN			
		Epoxy Primers	26	UK	EVAP			PROC			
		Polyurethane Paints	260	UK	CONTR			PROC			
Vehicle Maintenance (Motor Pool)	3646 3647	Engine Oil	500	UK	UK	FTA	CONTR	DRMO			
		PD-680	200	UK	UK	FTA	CONTR	DRMO			
		Sulfuric Acid	50-60	UK	N.S						
		Ethylene Glycol	220	UK	SAN						
		Transmission Fluid	60	UK		FTA	UK	DRMO			
		Brake Fluid (Silicone)	15	UK		FTA		PROC			
		Grease (Bearing)	1	UK		FTA		PROC			
		Other Chassis Grease	200 lbs/Yr.	UK		FTA		PROC			
		Cleaning Comp./Degreaser	75	UK		FTA		PROC			
		Safety-Kleen Solvent	200						CONTR		
		Clean Comp. Gas Path	12	UK		FTA		PROC			
Fuels Management (1) Liquid Fuels	3635	Tank Cleaning Sludge	75	UK		CONTR		DRMO		DRMO	
		Other Mixed Fuels	9700	UK		CONTR		DRMO			
		Transmission Fluid	50	UK		CONTR		PROC			
		Methanol	10	UK		CONTR		PROC			
		Ether	50	UK		CONTR		PROC			
Hangar Spaces (1) R & R Shop (2) Phase Docks (3) Pneudraulics	3649	PD-680	270	UK	FTA	CONTR		DRMO			
		Other Paint Strippers	60	UK	CONTR			DRMO			
		Safety Kleen Solvents	270						CONTR		
		Hydraulic Fluid	300	UK		CONTR		DRMO			
		111 Trichloroethane	50	UK		CONTR		EVAP			
		Lubricating Oils	5	UK		CONTR		PROC			
Machine Shop	3649	Metal Cutting Oils	1	UK		CONTR		PROC			
		Lubricating Oils	2 Qts	UK		CONTR		PROC			
		111 Trichloroethane	13	UK	DP		UK	EVAP			

TABLE IVA. HAZARDOUS MATERIALS/HAZARDOUS WASTE DISPOSAL SUMMARY CONTINUED
VaANG, RICHMOND INTERNATIONAL AIRPORT
SANDSTON, VIRGINIA

Shop	Building No. (Past & Present)	Hazardous Materials/ Hazardous Waste	Estimated Quantities (Gal./Year)	1950	1960	1970	1980	1985	1986	1987	1988
Plumbing Shop	3629	Cutting Oil	2	UK				PROC			
		Drain Openers	1	UK		CONTR		SAN			
Electric Shop	3649	Potassium Hydroxide	240 Cells/Yr	UK	N.S			DRMO			
Air conditioning & Refrigeration	3629	Refrigerator Oil	6	UK				PROC			
		Other FREONS	600 lbs/Yr.	UK				PROC			
Photo Lab	3652	Developer	35	UK		DPDO	UK	SAN			
Medical/Dental X-Ray	3654	Fixer	60	UK		DPDO	UK	DRMO			
Paint Shop (1) CE-Power Prod.	3629	Thinners	65	UK	EVAP			DRMO			
(2) RMS-Body & Paint Shop	3646	Methanol	5	UK	EVAP			PROC			
	3647	Stripper Residue	2	UK	EVAP			PROC			
		Spray Booth Wash	100	UK				SAN			
		Polyurethane Paints	60	UK	CONTR			PROC			
		Aerosol Paints	14	UK	CONTR			PROC			
		Corr. Remov. Comp.	5	UK	N.S		PROC				
Entomology (1) Roads & Ground	3629	Motor Oil	110	UK		CONTR	DRMO				
(2) Power Production		Pesticides	90	UK	N.S		PROC				
(3) Entomology		Empty Pesticide Containers	27 Cont/Yr.	UK				N.D			
		Rinse Water	30	UK	N.S			PROC			
Non-Destructive Inspection (NDI)	3649	Developer	10	UK		SAN					
Soap [illegible]oratory		Fixer	40	UK	SAN	[illegible]		DRMO			
		[illegible] ISOPAR-[illegible]	[illegible]	[illegible]		[illegible]		DRMO			
		[illegible] Stripper	[illegible]	[illegible]			[illegible]	DRMO			
		[illegible]oroethane	[illegible]					DRMO			
		[illegible] Comp.	[illegible]					DRMO			
		[illegible]line	3	[illegible]	PROC			[illegible]			

TABLE IVA. HAZARDOUS MATERIALS/HAZARDOUS WASTE DISPOSAL SUMMARY CONTINUED
VaANG, RICHMOND INTERNATIONAL AIRPORT
SANDSTON, VIRGINIA

Shop	Building No. (Past & Present)	Hazardous Materials/ Hazardous Waste	Estimated Quantities (Gal/Year)	1950	1960	1970	1980	1985	1986	1987	1988
Weapons Maintenance											
(1) Ammunition	3609	Rifle Bore Cleaner	24	UK		CONTR		PROC			
Storage & Maint.		Thinners/Lacquers	60	UK		CONTR		EVAP			
(2) Weapons Loading	3633	PD-680	220	UK		CONTR		DRMO			
(3) Missile Maint.	3660	Other Lube Oils	15	UK		CONTR		PROC			
(4) Weapons Release	3633	Safety-Kleen Solvent	250	___	___	___	___	___	CONTR		
(5) Gun Services	3633	Aerosol Primers	13	UK		CONTR		PROC			
		Paint Stripper	1	UK		CONTR		DRMO			
		Brake Fluid, Silicone	2	UK		CONTR		PROC			
		Polyurethane	4	UK		CONTR		PROC			

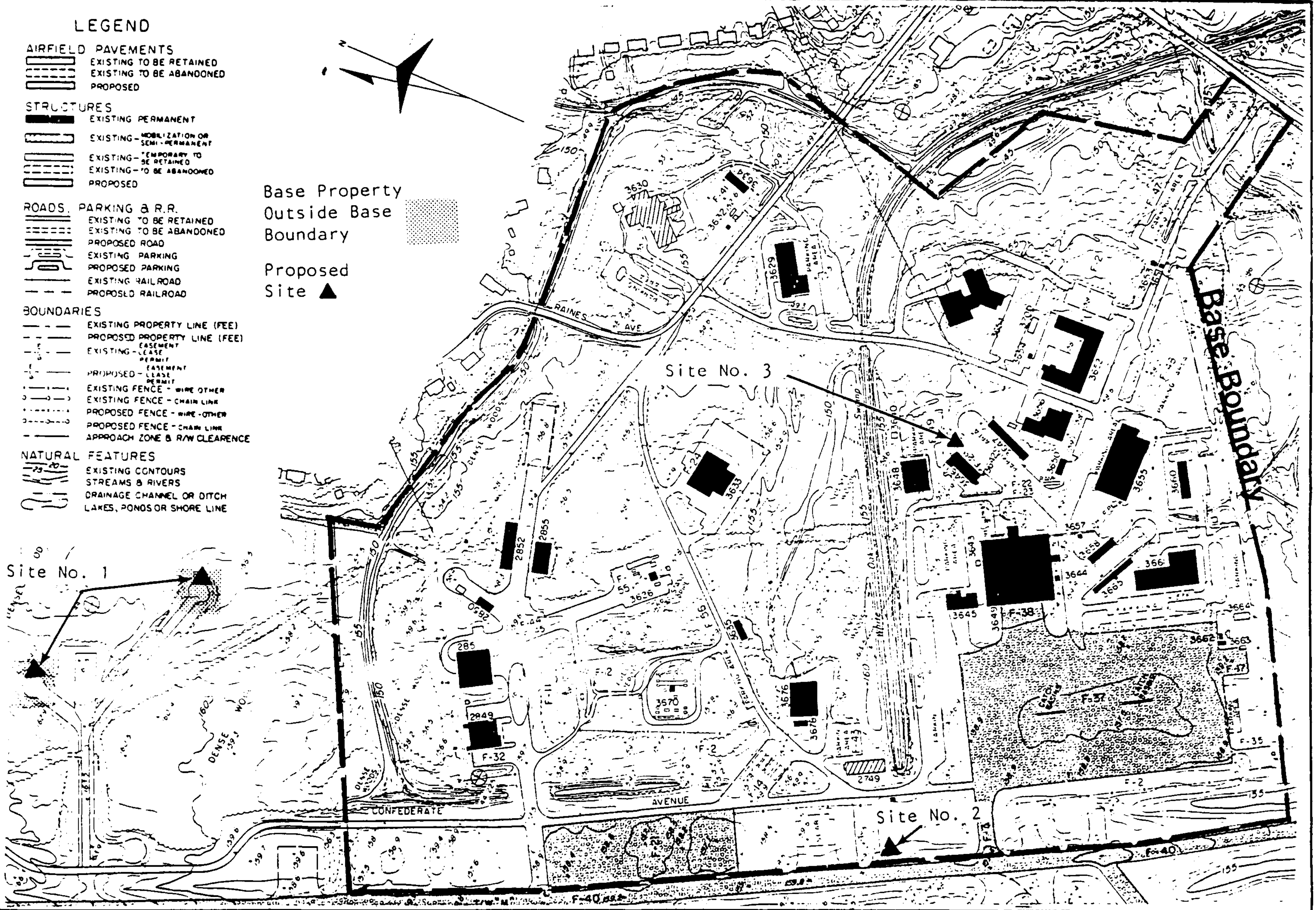
ACRONYMS:

SAN - Disposed of in drains leading to sanitary sewer.
STRM - Disposed of in drains leading to storm sewers.
DRMO - Disposed of through DRMO.
FTA - Disposed of at Fire Training Area.
N.S. - Neutralized & disposed of through sanitary sewer.
DPDO - Disposed of through DPDO.

EVAP - Evaporation in process.
PROC - In process.
CONTR - Disposed of by contractor.
N.D. - Neutralized then disposed at off base landfill.
D.P. - Disposed as pesticide.
U.K. - Unknown disposal source.

TABLE IVB VaANG BUILDING NUMBER AND IDENTIFICATION

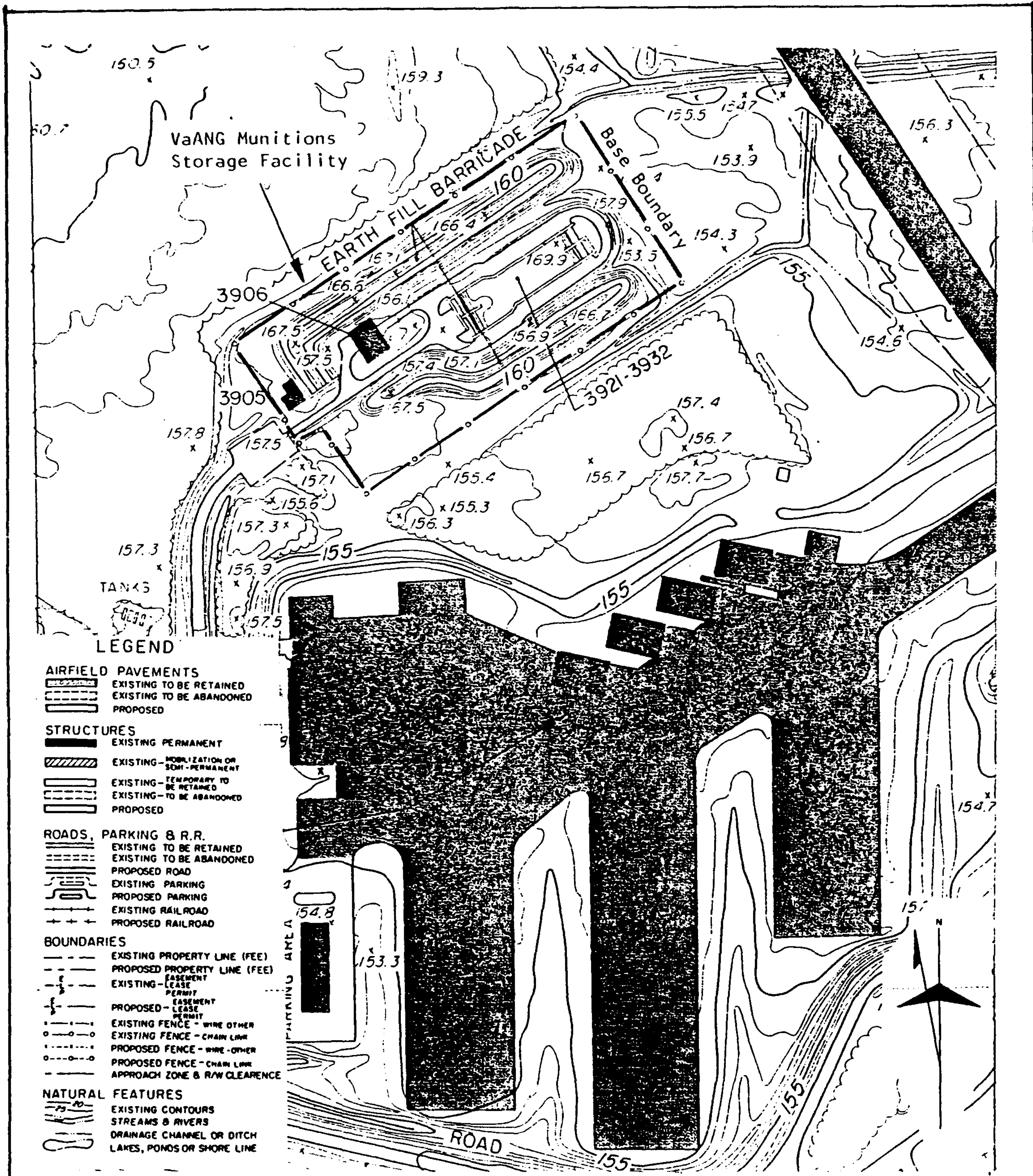
BLDG. NO.	BLDG. NAME
2849	Aerospace Ground Equipment Maintenance
2851	Corrosion Control
3629	Base Civil Engineering
3633	Weapons Release
3635	Petroleum Operations Building
3646	Vehicle Maintenance Shop
3647	Vehicle Maintenance Shop
3648	Avonics/Maintenance Engine Shop
3649	Hangar
3652	Resident Forces Operational Training
3654	Medical and Dining Facility
3660	Rocket Storage
3905	Munitions Storage Area
3906	Munitions Storage Area



Source: VaANG Civil Engineering

Scale: 1"=400'

Figure IVA. Site Location Map Proposed Sites 1-4



SCALE
1''=200'

Figure IVB. VaANG Munitions Storage Facility

Source: VaANG Civil Engineering

At the present time the hardstands are not in use. However the adjacent taxiway is used as a holding area for munitions trailers. Although Site No. 1 is outside the Base boundary, the hardstands are still on ANG real property records.

Site No. 2 - Bowser Holding Area (HAS-62)

Site No. 2 is an unmarked informally designated parking area for bowsers awaiting transport and decanting. Bowsers are mobile steel drums used for collecting defueled, off-spec JP-4. The bowser parking area is actually the asphalt shoulder of an old, now unused, taxiway. Base interviewees estimated that this site was used in excess of 15 years.

Visual on-site inspection clearly revealed evidence of JP-4 release and migration. Approximately 100 square feet of asphalt pad underlying the bowser holding drums was highly deteriorated. Vegetative stress (dead grass) was visible in an area adjoining the bowser parking area. Surficial soils within the adjacent drainage swale were oil stained and had a characteristic petroleum odor.

The sources of the past JP-4 releases from the bowsers were poorly sealed pipe connections and valves. The areal extent of contamination indicated that small volumes (possibly less than 100 gallons) of JP-4 have previously been released.

Site No. 3 - Vehicle Maintenance Waste Storage Area (HAS-61)

Site No. 3 is the Vehicle Maintenance Waste Storage Area located at the Northeast corner of building 3646 (vehicle maintenance). The location of Site No. 3 in relation to building No. 3646 and other Base facilities is illustrated in Figure IV.A. Site No. 3 has been used as a waste storage area since 1973. The bulk of materials stored at this site has been waste lubricating oils. In addition, smaller amounts (55 gallons at a time) of paint waste may have been stored at Site No. 3 in the past.

Interviews with Base personnel indicated that small amounts (possibly less than 100 gallons) of waste oil had been released from Site No. 3. The

contaminant release may have occurred as waste oil was transferred into holding drums. Also improperly sealed drums may have released waste oil as a result of rainwater displacement.

Visual on-site inspection clearly revealed evidence of waste oil release and migration. An area of surficial soil (approximately 10 feet wide and 30 feet long) directly adjacent to the waste oil holding drums was oil stained and had a characteristic petroleum odor. This area of oil stained surficial soil contained visible evidence of stress vegetation (dead grass). Also, an extensive oil sheen was observed on surface water within a drainage ditch directly adjoining this area.

C. OTHER PERTINENT FACTS

- Sanitary sewage from the Base flows to the county pumping station next to White Oak Creek, directly across the highway (Beulah Road) from the Base boundary. From there, sewage is pumped to the Richmond Municipal sewage treatment plant on the south side of the James River near where Interstate 95 crosses the river.

- There is no indication, from inventory records, or from interviews, that there has been any release from the active POL Storage Facility.

- There is no indication from inventory records, or from interviews, that there has been any release from the Air National Guard's munitions storage area located adjacent to the Army Guard's Aviation Support Facility on the south side of the airport.

- There are no present or past landfills, trash and/or solid waste disposal sites on the Base. This effort has historically been accomplished by the Base through service contracts with either the airport or the county.

- All drainage ditches from industrial areas of the Base have sediment barriers and/or absorbent materials in place. Interviewees stated that this practice has been utilized for at least 20 years.

- A past JP-4 spill occurred at the aircraft parking apron in the mid 1960's. 900 gallons of JP-4 was released onto the aircraft apron from two 450 gallon aircraft fuel tanks. At the time of the spill, the released JP-4 was washed down with fresh water into the Base storm sewer drainage.

- The Base Fire Department co-ordinates the Spill Response Program. Records and interviews indicated that there have been no significant spills at the Base since the JP-4 spill in the mid 1960's.

- ANG regulation 19-7 and supplemental information issued since the 15 October 1985 issue outlines the Environmental Pollution Monitoring Program.

- An outside private contractor had removed and placed into sealed drums the lead contaminated source of the Small Arms Range.

- The fire training exercises are conducted on a facility owned by the Capital Regional Airport Commission.

V. CONCLUSIONS

- o Interviews with present and former Base personnel, review and evaluation of Base records, and on-site inspection of Base facilities identified 3 potentially contaminated, rated sites on Base property.

- o An on-site inspection of sites No. 2 & 3 identified visible evidence (oil sheen on surface water, oil stained soil, POL odor) of petroleum hydrocarbon release and migration.

- o Base records confirmed that site No. 1 was a past disposal site for waste trichloroethylene.

- o It was concluded by the Harm methodology that each of the 3 rated sites have the potential for contaminant migration through surface water or shallow groundwater.

VI. RECOMMENDATIONS

Based on the evidence of contamination and/or potential for contamination derived from on-site inspections, research of Base records, interviews with present and past Base personnel, and the HAS scores, it is recommended that a follow up IRP Site Investigation be initiated at each of the three rated sites.

BIBLIOGRAPHY

1. Wigglesworth, Haywood A., Perry, Timothy W. and Ellison, Russell P. III., Groundwater Resources of Henrico County Virginia, Commonwealth of Virginia State Water Control Board, Planning Bulletin 328, 1984.

2. Clay, John W., Soil Survey of Henrico County, Virginia, United States Department of Agriculture, Soil Conservation Service.

3. Sax, Irving N., Dangerous Properties of Industrial Materials, 6th Edition Van Nostrand Reinhold, 1984.

4. Occupational Health Guidelines for Chemical Hazards DHHS (NIOSH) Publications No-81-123, 1981.

5. United States Environmental Protection Agency, Federal Register, Vol. 47, Page 31180, July 18, 1982, Government Printing Office, Washington, D.C.

6. Golden Wings Over Richmond, 1927-1977, Wings Publishing Co., 1977.

7. United States Geological Survey; Seven Pines, Virginia, 7.5 Minute Series, USGS Topographic, 1981.

8. United States Geological Survey; Dutch Gap, Virginia, 7.5 Minute Series, USGS Topographic, 1981.

9. Virginia Air National Guard, 192d Tactical Fighter Group, Virginia Air National Guard BYRD International Airport, Sandston, Virginia.

10. Annual Summary, Local Climatalogical Data, published by NOAA (National Oceanic and Atmospheric Administration).

11. HMTC, 1987, Preliminary Assessment, 187th Tactical Fighter Group, Dannelley Field Municipal Airport, Montgomery, Alabama.

12. PEER, 1988, Preliminary Assessment, 128 Tactical Fighter Wing, Wisconsin Air National Guard, Dane County Regional Airport/Truex Field, Madison, Wisconsin.

GLOSSARY OF TERMS

AQUIFER - Stratum or zone below the surface of the earth capable of producing water as from a well.

AQUICLUDE - A formation that will not transmit water fast enough to furnish an appreciable supply for a well or spring.

CONTAMINANT - As defined by Section 101 (33) of SARA shall include, but not be limited to any element, substance, compound, or mixture, including disease-causing agents, which after release into the environment and upon exposure, ingestion, inhalation, or assimilation into any organism, either directly from the environment or indirectly by ingestion through food chains, will or may reasonably be anticipated to cause death, disease, behavioral abnormalities, cancer, genetic mutation, physiological malfunctions (including malfunctions in reproduction), or physical deformations in such organisms or their offsprings, except that the term "contaminant" shall not include petroleum, including crude oil or any fraction thereof which is not otherwise specifically listed or designated as a hazardous substance under:

(a) any substance designated pursuant to Section 311(b)(2)(A) of the Federal Water Pollution Control Act,

(b) any element, compound, mixture, solution, or substance designated pursuant to Section 102 of this Act,

(c) any hazardous waste having the characteristics identified under or listed pursuant to Section 3001 of the Solid Waste Disposal Act (but not including any waste the regulation of which under the Solid Waste Disposal Act has been suspended by Act of Congress).

(d) any toxic pollutant listed under Section 307(a) of the Federal Water Pollution Control Act,

(e) any hazardous air pollutant listed under Section 112 of the Clean Air Act, and

(f) any imminently hazardous chemical substance or mixture with respect to which the Administrator has taken action pursuant to Section 7 of the Toxic Substance Control Act and shall not include natural gas of pipeline quality or mixtures of natural gas and such synthetic gas.
NOTE: Petroleum products are covered in other regulations. In the state of Virginia wastes from petroleum products do not become RCRA hazardous wastes unless they fall under any of the USEPA guidelines for identifying hazardous wastes:

(1) Listed hazardous wastes from certain specific and non-specific sources.

(2) Listed acutely hazardous wastes.

(3) Listed wastes that contain materials and products based on the criteria for toxicity.

(4) Wastes that meet any of four characteristics of hazardous waste, i.e., ignitability, reactivity, corrosivity, and extraction procedure toxicity (EP toxicity).

CONTAMINATION - The existence of biological, radiological, chemical, or other substances which have been identified as or may present a hazard to health or may render some portion of the environment unsuitable for use.

CRITICAL HABITAT - The native environment of an animal or plant which, due either to the uniqueness of the organism or the sensitivity of the environment, is susceptible to adverse reactions in response to environmental changes such as may be induced by chemical contaminants.

DOWNGRADIENT - Hydraulically downslope direction of groundwater flow.

ENDANGERED SPECIES - Plant or wildlife species designated as endangered by the U.S. Fish and Wildlife Service.

GROUNDWATER - That part of the subsurface water which is the zone of saturation.

HAZARD ASSESSMENT RATING METHODOLOGY (HARM) - a system adopted and used by the United States Air Force to develop and maintain a priority listing of potentially contaminated sites on installations and facilities for remedial action based on potential hazard to public health and environmental impacts.

HAZARD ASSESSMENT SCORE (HAS)- The score developed by utilizing the Hazardous Assessment Rating Methodology.

HAZARDOUS WASTE - A solid or liquid waste that because of its quantity, concentration, or physical, chemical, or infectious characteristics may

(a) cause or significantly contribute to an increase in mortality or an increase in serious irreversible or incapacitating reversible illness, or

(b) pose a substantial present or potential hazard to human health or the environment when improperly treated, store, transported, disposed of, or otherwise managed.

INSTALLATION RESTORATION PROGRAM (IRP) - The DoD program for identifying the location of and releases of hazardous materials from past disposal sites and minimizing their associated hazards to public health.

LOAM - A soil composed of a mixture of clay, silt and organic matter.

MIGRATION - The movement of contaminants through pathways (groundwater, surface water, soil and air).

NATURAL AREA - Designated areas with critical habitat or endangered species protected from human exploitation by federal or state laws.

PERMEABILITY - Capacity of a rock, soil or unconsolidated sediment to transmit a fluid over a given period of time.

PHYSIOGRAPHIC PROVINCE - Region of similar structure and climate that has had a unified geomorphic history.

SURFACE WATER - Water exposed on ground surface, i.e., lakes, streams, rivers, etc.

SWALE - A low lying or depressed and often wet stretch of land.

TOXICITY - A relative property of a chemical agent and refers to a harmful effect on some biologic mechanism and the condition under which this effect occurs.

UPGRADIENT - A direction that is hydraulically upslope.

WATERTABLE - The upper limit of the portion of the ground wholly saturated with water.

WETLANDS - Those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas.

Appendix A
Resumes of Search Team Members

JACK DENTON WHEAT
Geologist/Hydrogeologist

EDUCATION

B.S. Geology - Tennessee Technological University

EXPERIENCE

Geologist/Hydrogeologist, Science & Technology, Inc.
1988 - Present

Preliminary assessment (PA) Phase I of the Department of Defense Installation Restoration Program (IRP). Primary contributions include the Geology and Hydrogeology of designated military installations and the susceptibility of principal ground water aquifers to contamination from surface pollutants. Also RCRA regulations were evaluated concerning the Department of Defense Hazard Assessment Rating Methodology (HARM).

Geological Assistant, Robert Stansfield Consulting Geologist
1987

Drilling and installation of monitor wells to further identify potential groundwater contaminants. Monitor wells were installed and developed at EPA superfund sites. OSHA and EPA regulations concerning safety work procedures and protection requirements were followed at EPA superfund sites. The EPA standards for post drilling decontamination of contaminated site equipment were also utilized at superfund sites.

Field Hydrogeologist, Oak Ridge National Laboratory (ORNL)
February 1987 - May 1987

Field Geologist for the Department of Energy, Bethel Valley Low Level Waste (LLW) pipeline project. Major geological functions included soil sample analysis for individual borings, soil sampling techniques, and the inspection of drilling procedures to follow specified regulations. Monitor wells were installed when necessary to evaluate ground water contamination. Individual LLW boring reports were compiled to include soil sample descriptions, zone of ground water saturations, levels of radioactive contamination, and the individual boring location. A monitor well schematic construction log was included with a monitor well installation. Additional functions at ORNL included

assistance in obtaining the necessary required DOE documents, i.e., ADM ACDM, Safety Assessment, prior to project initiation. Also a work plan was compiled for ORNL Environmental Science Division concerning a test trench site to evaluate pipeline trench back fill. The areas of activity at ORNL included ORNL plant area and SWSA 6.

Consulting Geologist, Oil & Gas Industry
1980 - 1986

Consulting geologist for oil and gas companies with operations in Tennessee, Kentucky & Illinois. Major functions included wellsite geology and sample analysis of exploration drillsite cuttings. Drilling procedures, i.e.,grout surface casing, lined pits to retain drilling fluids, were supervised to follow state regulations regarding the contamination of surface streams or groundwater aquifers. Geologic reports were compiled to include stratigraphic formation lithology and oil or gas potential payzones, and geologic maps, i.e., structure contours, insopachs, to pinpoint the desired location to drill. Oil and gas well location maps were drafted for map sales and assistance in drawing geologic maps.

Geologist, Petroleum Development Corporation
1977 -1980

Geological Functions at Petroleum Development were quite similar to the previously described consulting geologist. Geological duties at Petroleum Development were predominately Field Geology, i.e., sample analysis, drilling supervision, etc., with only few assignments in geological reports, subsurface mappings, etc. Well location maps were down for assistance in exploration oil or gas programs.

HAZARDOUS WASTE TRAINING

Seminars were conducted at ORNL, February 1987 on the types of radioactive nuclides, i.e., Alpha Beta, Gamma, and the transmitters of radioactive contaminants. The training and qualification for respirator usage was also conducted at ONRL. OSHA Safety Standards were issued at EPA Superfund sites.

GEOLOGICAL REGISTRATION

Presently, I have been approved as a licensed professional geologist for the State of North Carolina.

JAMES E. HUNT
Sr. Chemical/Environmental Engineer

EDUCATION

B.S. Chemical Engineering - Bucknell University
M.S. Chemical Engineering - Iowa State University

EXPERIENCE

Chemical Engineer, Science & Technology, Inc.
1988 - Present

Group leader of the USAF Installation Restoration Program (IRP) Preliminary Assessment (PA). Tennessee Air National Guard, McGhee-Tyson Municipal Airport, Knoxville, Tennessee.

Team member of the USAF Installation Restoration Program (IRP) Preliminary Assessment (PA). Virginia Air National Guard, Byrd International Airport, Richmond, Virginia.

Senior Chemical Engineer, Tennessee Eastman Company
1978 - 1987

In charge of Acid Division Clean Environment Program, Chemical and Environmental Engineer. Waste Minimization, Air Emission Control, Cleanwater Regulatory Activity, Toxic and Hazard Waste Management, Process Optimization for Waste Minimization.

Senior Chemical Engineer, Tennessee Eastman Company
1974 - 1978

Project Manager for major capital expansion for chemical manufacture. Supervisor chemical pilot plant operations and development work.

Senior Chemical Engineer, Tennessee Eastman Company
1973 - 1974

Project Engineer for several major capital projects in company's Central Engineering Division. Project Engineer for capital project working with outside contracting engineering firm.

Senior Chemical Engineer, Tennessee Eastman Company
1964 - 1973

Operating chemical division process improvement work, in charge of several large chemical operating manufacturing departments.

Chemical Engineer, Tennessee Eastman Company
1958 - 1964

Chemical engineering with pilot plant and high pressure operations

Grad Assistant, Instructor Chemical Engineering Department, Iowa State University
1955 - 1958

Chemical Engineer, Naugatuck Chemical (Uniroyal)
1953 - 1955

Supervisor of Polymerization Pilot Plant

Chemical Engineer, Koppers Co., Inc.
1951 - 1953

Pilot plant engineering and development work.

PROFESSIONAL MEMBERSHIP

American Institute of Chemical Engineers
Alpha Chi Sigma
Phi Lambda Upsilon

RANDALL HUGH NESMITH

EDUCATION

Associate of Arts, emphasis on Earth Science - Okaloosa-Walton Junior College, Niceville, FL.

Course Work leading to the Bachelor of Science in Geology - Auburn University, Auburn, Al.

B. S., Geology - University of South Carolina

Hydrology Field Course - University of Arizona

Engineering Economics - Midland Technical College

Hazardous Waste Management - Air Force Institute of Technology

EXPERIENCE

Team Leader, Installation Restoration Program (IRP)
January 1988 - Present

Phase I of the IRP Program.

Staff Scientist, Dynamic Corporation
1985 - 1988

Provides management and technical assistance on environmental programs, under contract to Air Force installations. Prepares hazardous waste management plans, state and federal permit applications, training programs, contingency plans and other reports as necessary. Directs compliance actions in accordance with local, state, and federal regulations. Formulates, implements, and evaluates Remedial Action Plans. Serves as liaison between Air Force installations and regulatory agencies.

Geohydrologist - South Carolina Department of Health and Environmental Control. 1984 - 1985

Responsible for technical oversight of the South Carolina Underground Injection Control Program. Performed technical evaluations of engineering proposals. Conducted geohydrologic field investigations of new and existing waste disposal sites. Designed ground-water monitoring networks. Supervised well installation projects. Assisted with development of South Carolina underground storage tank regulations. Supervised five geologists/geologic technicians.

Geology Laboratory Supervisor, University of South Carolina
1983 - 1984

Supervised four laboratory technicians. Develooed and directed sample preparation techniques. Developed and directed sample preparation techniques. Supervised drilling of stratigraphic borings. Logged bore holes and interpreted collected data.

Weapons Supervisor/Security Specialist. United States Air Force.
1973 - 1979

Directed installation of weapons and weapons systems on USAF aircraft. Responsible for analysis and correction of system malfunctions. Monitored and controlled physical safety and security of Air Force installations and resources. Supervised 35 personnel.

Appendix B
Outside Agency Contact List

OUTSIDE AGENCIES

(1) United States Geological Survey
3600 West Broad Street
Room 606
Richmond, VA 23230
(804) 771-2427

(2) Virginia Soil & Water Conservation
Piedmont Dist.
2201 West Broad Street
Richmond, VA 23220
(804) 367-6667

(3) Virginia Department of Game Inland & Fisheries
4010 W. Broad Street
Richmond, VA 23230
(804) 367-8747

(4) U.S.D.A. Soil Conservation Service
400 North - East Street
Richmond, VA 23240
(804) 771-2413

(5) Virginia Department of Agriculture & Consumer Services
Bureau of Plant Protection
P.O. Box 1163
Richmond, VA 23209
(804) 786-3516

(6) Virginia Natural Heritage Program
1100 Washington Building
Capital Square
Richmond, VA 23219
(804) 786-2121

(7) Henrico Department of Health Eastern Office
P.O. Box 27032
Richmond , VA 23273
(804) 672-4530

(8) Henrico County Planning Office
P.O. Box 27032
Richmond, VA 23273
(804) 747-4602

Appendix C
USAF Hazard Assessment Rating Methodology

USAF HAZARD ASSESSMENT RATING METHODOLOGY

The Department of Defense (DoD) has developed a comprehensive system to identify, evaluate and control hazardous waste problems associated with past waste disposal techniques at DoD facilities. One of the actions required under this system is to:

> develop and maintain a priority listing of contaminated installations and facilities for remedial action based on potential hazard to public health, welfare, and environmental impacts. (Reference: DEQPPM 81-5, 11 December 1981).

The USAF system will set a priority listing of contaminated installations and facilities for remedial action based on information gathered in the Records Search "Phase No. I" of the IRP.

PURPOSE

The purpose of the site rating model is to assign a ranking to each site where there is suspected contamination from hazardous substances. The information derived will assist in additional individual site investigations.

An individual site ranking score will be assigned if (1) hazardous substances are present in sufficient quantities, (2) there is potential for migration. A site may be deleted from ranking consideration on either basis.

DESCRIPTION OF THE MODEL

Similar to other ranking models, the United States Air Force USAF model has established a score system to give priority when necessary to individual sites. However, the USAF has modified procedures for their specific needs. Individual site scores will be computed by the HARM model flow chart illustrated in Figure IA. HARM rating forms and rating factors are illustrated at the end of this Appendix. The HARM system subdivides hazardous risks into four categories: possible receptors of contaminants, waste characteristics, potential pathways for contaminants, and waste management practices.

The receptors category is subdivided into 9 rating factors which describe: potential for human exposure to contaminants, population adjacent to site, potential for surface or groundwater contamination, potential of the adverse effect upon critical environment and habitats, and the current and projected use of property surrounding the site perimeter. Each rating factor is assigned a factor rating value of 0-3 which is increased by a multiplier to ascertain an individual factor score. A maximum possible score is also computed. The receptors subscore is computed by 100 x factor score subtotal/maximum score subtotal.

The waste characteristics category is scored in three steps. First, a point rating is assigned based on an assessment of the waste quantity and the hazard (worst case) associated with the site. The level of confidence in the information is also factored into the assessment. Next the score is multiplied by a persistence factor, which acts to reduce the score if the waste is not very persistent. Finally, the score is further modified by the physical state of the waste. Liquid wastes receive the maximum score, while scores for sludges and solids are reduced.

The pathways category is based on evidence of contamination migration or an evaluation of the highest potential (worst case) for contamination migration along one of three pathways: surface-water migration, flooding, and groundwater migration. If evidence of contaminant migration exists, the category is given a subscore of 80 to 100 points. For indirect evidence, 80 points are assigned and for direct evidence 100 points are assigned. If no evidence is found, the highest score among three possible routes is used. The three pathways are evaluated and the highest score among all four of the potential scores is used.

The scores for each of the three categories are then added together and normalized to a maximum score of 100. Then the waste management practice category is scored. Sites at which there is minimum containment can be reduced by five percent. If a site is contained and well managed, its score can be reduced by 90 percent. The final site score is calculated by applying the waste management practices category to the sum of the scores for the other three categories.

HAZARDOUS ASSESSMENT RATING FORM

NAME OF SITE ______________________________

LOCATION ______________________________

DATE OF OPERATION OR OCCURRENCE ______________________________

OWNER/OPERATOR ______________________________

COMMENTS/DESCRIPTION ______________________________

SITE RATED BY ______________________________

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
A. Population within 1,000 ft. of site		4		
B. Distance to nearest well		10		
C. Land use/zoning within 1 mile radius		3		
D. Distance to installation boundary		6		
E. Critical environments within 1 mile radius of site		10		
F. Water quality of nearest surface water body		6		
G. Groundwater use of uppermost aquifer		9		
H. Population served by surface water supply within 3 miles downstream of site		6		
I. Population served by groundwater supply within 3 miles of site		6		
		Subtotals	______	______

Receptors subscore (100 x factor score subtotal/maximum score subtotal) ______

II. WASTE CHARACTERISTICS

A. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity (S = small, M = medium, L = large) ______
2. Confidence level (C = confirmed, S = suspected) ______
3. Hazard rating (H = high, M = medium, L = low) ______

Factor Subscore A (from 20 to 100 based on factor score matrix) ______

B. Apply persistence factor
Factor Subscore A x Persistence Factor = Subscore B

______ x ______ = ______

C. Apply physical state multiplier
Subscore B x Physical State Multiplier = Waste Characteristics Subscore

______ x ______ = ______

III. PATHWAYS

Rating Factor	Factor Rating (0-3)	*Multiplier*	Factor *Score*	Maximum Possible *Score*

A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points for direct evidence or 80 points for indirect evidence. If direct evidence exists then proceed to C. If no evidence or indirect evidence exists, proceed to B.

Subscore ______

B. Rate the migration potential for 3 potential pathways: Surface water migration, flooding, and groundwater migration. Select the highest rating, and proceed to C.

1. Surface water migration

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
Distance to nearest surface water		8		
Net precipitation		6		
Surface erosion		8		
Surface permeability		6		
Rainfall intensity		8		
		Subtotals	______	______

Subscore (100 x factor score subtotal/maximum score subtotal) ______

2. Flooding

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
Flooding		1		

Subscore (100 x factor score/3) ______

3. Groundwater migration

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
Depth to groundwater		8		
Net precipitation		6		
Soil permeability		8		
Subsurface flows		8		
Direct access to groundwater		8		
		Subtotals	______	______

Subscore (100 x factor score subtotal/maximum score subtotal) ______

C. Highest pathway subscore

Enter the highest subscore value from A, B-1, B-2 or B-3 above.

Pathways Subscore ______

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors ______
Waste Characteristics ______
Pathways ______

Total ______ divided by 3 = ______
Gross Total Score

B. Apply factor for waste containment from waste management practices

Gross Total Score x Waste Management Practices Factor = Final Score

______________ x ______________ = $\boxed{\quad}$

HAZARDOUS ASSESSMENT RATING METHODOLOGY GUIDELINES

I. RECEPTORS CATEGORY

		Rating Scale Levels				
	Rating Factors	0	1	2	3	Multiplier
A.	Population within 1,000 feet (includes on-base facilities)	0	1-25	26-100	Greater than 100	4
B.	Distance to nearest water well	Greater than 3 miles	1 to 3 miles	3,001 feet to 1 mile	0 to 3,000 feet	10
C.	Land use/zoning (within 1-mile radius)	Completely remote (zoning not applicable)	Agricultural	Commercial or Industrial	Residential	3
D.	Distance to installation boundary	Greater than 2 miles	1 to 2 miles	1,001 feet to 1 mile	0 to 1,000 feet	6
E.	Critical environments (within 1-mile radius)	Not a critical environment	Natural areas	Pristine natural areas; minor wetlands; preserved areas; presence of economically important natural resources susceptible to contamination	Major habitat of an endangered or threatened species; presence of recharge area; major wetlands	10
F.	Water quality/use designation of nearest surface water body	Agricultural or industrial use	Recreation, propagation and management of fish and wildlife	Shellfish propagation and harvesting	Potable water supplies	6
G.	Groundwater use of uppermost aquifer	Not used, other sources readily available	Commercial industrial, or irrigation, very limited other water sources	Drinking water, municipal water available	Drinking water, no municipal water available, commercial, industrial, or irrigation; no other water source available	9
H.	Population served by surface water supplies within 3 miles downstream of site	0	1-15	51-1,000	Greater than 1,000	6
I.	Population served by aquifer supplies within 3 miles of site	0	1-50	51-1,000	Greater than 1,000	6

II. WASTE CHARACTERISTICS

A-1 Hazardous Waste Quantity

S = Small quantity (5 tons or 20 drums of liquid)
M = Moderate quantity (5 to 20 tons or 21 to 85 drums of liquid)
L = Large quantity (20 tons or 85 drums of liquid)

A-2 Confidence Level of Information

C = Confirmed confidence level (minimum criteria below)

- o Verbal reports from interviewer (at least 2) or written information from the records
- o Knowledge of types and quantities of wastes generated by shops and other areas on base

S = Suspected confidence level

- o No verbal reports or conflicting verbal reports and no written information from the records
- o Logic based on a knowledge of the types and quantities of hazardous wastes generated at the base, and a history of past waste disposal practices indicate that these wastes were disposed of at a site

A-3 Hazard Rating

Rating Factors	Rating Scale Levels 0	1	2	3
Toxicity	Sax's Level 0	Sax's Level 1	Sax's Level 2	Sax's Level 3
Ignitability	Flash point greater than 200°F	Flash point at 140°F to 200°F	Flash point at 80°F to 140°F	Flash point less than 80°F
Radioactivity	At or below background levels	1 to 3 times background levels	3 to 5 times background levels	Over 5 times background levels

Use the highest individual rating based on toxicity, ignitability, and radioactivity and determine the hazard rating.

Hazard Rating	Points
High (H)	3
Medium (M)	2
Low (L)	1

II. WASTE CHARACTERISTICS--Continued

Waste Characteristics Matrix

Point Rating	Hazardous Waste Quantity	Confidence Level of Information	Hazard Rating
100	L	C	H
	L	C	M
80	M	C	H
70	L	S	H
	S	C	H
60	M	C	M
	L	S	M
	L	C	L
50	M	S	H
	S	C	M
	S	S	H
	M	S	M
40	M	C	L
	L	S	L
	S	C	L
30	M	S	L
	S	S	M
20	S	S	L

Notes:
For a site with more than one hazardous waste, the waste quantities may be added using the following rules:

Confidence Level
- o Confirmed confidence levels (C) can be added.
- o Suspected confidence levels (S) can be added.
- o Confirmed confidence levels cannot be added with suspected confidence levels.

Waste Hazard Rating
- o Wastes with the same hazard rating can be added.
- o Wastes with different hazard ratings can only be added in a downgrade mode, e.g., MCM + SCH = LCM if the total quantity is greater than 20 tons.

Example: Several wastes may be present at a site, each having an MCM designation (60 points). By adding the quantities of each waste, the designation may change to LCM (80 points). In this case, the correct point rating for the waste is 80.

B. Persistence Multiplier for Point Rating

Persistence Criteria	Multiply Point Rating From Part A by the Following
Metals, polycyclic compounds, and halogenated hydrocarbons	1.0
Substituted and other ring compounds	0.9
Straight chain hydrocarbons	0.8
Easily biodegradable compounds	0.4

C. Physical State Multiplier

Physical state	Multiply Point Total From Parts A and B by the Following
Liquid	1.0
Sludge	0.75
Solid	0.50

III. PATHWAYS CATEGORY

A. Evidence of Contamination

Direct evidence is obtained from laboratory analyses of hazardous contaminants present above natural background levels in surface water, groundwater, or air. Evidence should confirm that the source of contamination is the site being evaluated.

Indirect evidence might be from visual observation (i.e., leachate), vegetation stress, sludge deposits, presence of taste and odors in drinking water, or reported discharges that cannot be directly confirmed as resulting from the site, but the site is greatly suspected of being a source of contamination.

B-1 Potential for Surface Water Contamination

Rating Factors	0	1	2	3	Multiplier
Distance to nearest surface water (includes drainage ditches and storm sewers)	Greater than 1 mile	2,001 feet to a mile	501 feet to 2,000 feet	0 to 500 feet	8
Net precipitation	Less than -10 inches	-10 to +5 inches	+5 to +20 inches	Greater than +20 inches	6
Surface erosion	None	Slight	Moderate	Severe	8
Surface permeability	0% to 15% clay ($>10^{-2}$ cm/sec)	15% to 30% clay (10^{-2} to 10^{-4} cm/sec)	30% to 50% clay (10^{-4} to 10^{-6} cm/sec)	Greater than 50% clay ($>10^{-6}$ cm/sec)	6
Rainfall intensity based on 1-year, 24 hour rainfall (thunderstorms)	<1.0 inch	1.0 to 2.0 inches	2.1 to 3.0 inches	>3.0 inches	8
	0-5	6-35	36-49	>50	
	0	30	60	100	

B-2 Potential for Flooding

Rating Factors	0	1	2	3	Multiplier
Floodplain	Beyond 100-year floodplain	In 100-year floodplain	In 10-year floodplain	Floods annually	1

B-3 Potential for Groundwater Contamination

Rating Factors	0	1	2	3	Multiplier
Depth to groundwater	Greater than 500 feet	50 to 500 feet	11 to 50 feet	0 to 10 feet	8
Net precipitation	Less than -10 inches	-10 to +5 inches	+5 to +20 inches	Greater than +20 inches	6
Soil permeability	Greater than 50% clay ($>10^{-6}$ cm/sec)	30% to 50% clay (10^{-4} to 10^{-6} cm/sec)	15% to 30% clay 10^{-2} to 10^{-4} cm/sec	0% to 15% clay ($<10^{-2}$ cm/sec)	8
Subsurface flows	Bottom of site greater than 5 feet above high groundwater level	Bottom of site occasionally submerged	Bottom of site frequently submerged	Bottom of site located below mean groundwater level	8
Direct access to groundwater (through faults, fractures, faulty well casings, subsidence, fissures, etc.)	No evidence of risk	Low risk	Moderate risk	High risk	8

IV. WASTE MANAGEMENT PRACTICES CATEGORY

A. This category adjusts the total risk as determined from the receptors, pathways, and waste characteristics categories for waste management practices and engineering controls designed to reduce this risk. The total risk is determined by first averaging the receptors, pathways, and waste characteristics subscores.

B. Waste Management Practices Factor

The following multipliers are then applied to the total risk points (from A):

Waste Management Practice	Multiplier
No containment	1.0
Limited containment	0.95
Fully contained and in full compliance	0.10

Guidelines for fully contained:

Landfills:

- o Clay cap or other impermeable cover
- o Leachate collection system
- o Liners in good condition
- o Adequate monitoring wells

Spills:

- o Quick spill cleanup action taken
- o Contaminated soil removed
- o Soil and/or water samples confirm total cleanup of the spill

Surface Impoundments:

- o Liners in good condition
- o Sound dikes and adequate freeboard
- o Adequate monitoring wells

Fire Protection Training Areas:

- o Concrete surface and berms
- o Oil/water separator for pretreatment of runoff
- o Effluent from oil/water separator to treatment plant

General Note: If data are not available or known to be complete the factor ratings under items I-A through I, III-B-1, or III-6-3, then leave blank for calculation of factor score and maximum possible score.

Appendix D
Site Hazardous Assessment Rating Forms and Factor Rating Criteria

HAZARDOUS ASSESSMENT RATING FORM

NAME OF SITE Hardstand - Site No. 1

LOCATION

DATE OF OPERATION OR OCCURRENCE 1966-1971

OWNER/OPERATOR 192nd TFG, Virginia Air National Guard

COMMENTS/DESCRIPTION

SITE RATED BY Science & Technology, Inc.

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
A. Population within 1,000 ft. of site	3	4	12	12
B. Distance to nearest well	3	10	30	30
C. Land use/zoning within 1 mile radius	3	3	9	9
D. Distance to installation boundary	3	6	18	18
E. Critical environments within 1 mile radius of site	0	10	0	30
F. Water quality of nearest surface water body	1	6	6	18
G. Groundwater use of uppermost aquifer	1	9	9	27
H. Population served by surface water supply within 3 miles downstream of site	0	6	0	18
I. Population served by groundwater supply within 3 miles of site	3	6	18	18
Subtotals			102	180

Receptors subscore (100 x factor score subtotal/maximum score subtotal) 57

II. WASTE CHARACTERISTICS

A. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity (S = small, M = medium, L = large) S
2. Confidence level (C = confirmed, S = suspected) C
3. Hazard rating (H = high, M = medium, L = low) H

Factor Subscore A (from 20 to 100 based on factor score matrix) 60

B. Apply persistence factor
Factor Subscore A x Persistence Factor = Subscore B

60 x 1.0 = 60

C. Apply physical state multiplier
Subscore B x Physical State Multiplier = Waste Characteristics Subscore

60 x 1.0 = 60

III. PATHWAYS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score

A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points for direct evidence or 80 points for indirect evidence. If direct evidence exists then proceed to C. If no evidence or indirect evidence exists, proceed to B.

Subscore ______

B. Rate the migration potential for 3 potential pathways: Surface water migration, flooding, and groundwater migration. Select the highest rating, and proceed to C.

1. Surface water migration

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
Distance to nearest surface water	2	8	16	24
Net precipitation	3	6	18	18
Surface erosion	1	8	8	24
Surface permeability	1	6	6	18
Rainfall intensity	2	8	16	24
		Subtotals	64	108

Subscore (100 x factor score subtotal/maximum score subtotal) 59

2. Flooding

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
Flooding	1	1	1	3

Subscore (100 x factor score/3) 33

3. Groundwater migration

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
Depth to groundwater	2	8	16	24
Net precipitation	3	6	18	18
Soil permeability	1	8	8	24
Subsurface flows	1	8	8	24
Direct access to groundwater	0	8	0	24
		Subtotals	50	114

Subscore (100 x factor score subtotal/maximum score subtotal) 44

C. Highest pathway subscore

Enter the highest subscore value from A, B-1, B-2 or B-3 above.

Pathways Subscore 59

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors	57
Waste Characteristics	60
Pathways	59

Total 176 divided by 3 = 59 Gross Total Score

B. Apply factor for waste containment from waste management practices

Gross Total Score x Waste Management Practices Factor = Final Score

59 x 1.0 = $\boxed{59}$

HAZARDOUS ASSESSMENT RATING FORM

NAME OF SITE Bowser Holding Area, Site No. 2

LOCATION

DATE OF OPERATION OR OCCURRENCE Early 1950s - Present

OWNER/OPERATOR 192nd TFG, Virginia Air National Guard

COMMENTS/DESCRIPTION

SITE RATED BY Science & Technology, Inc.

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
A. Population within 1,000 ft. of site	3	4	12	12
B. Distance to nearest well	3	10	30	30
C. Land use/zoning within 1 mile radius	3	3	9	9
D. Distance to installation boundary	3	6	18	18
E. Critical environments within 1 mile radius of site	0	10	0	30
F. Water quality of nearest surface water body	1	6	6	18
G. Groundwater use of uppermost aquifer	1	9	9	27
H. Population served by surface water supply within 3 miles downstream of site	0	6	0	18
I. Population served by groundwater supply within 3 miles of site	3	6	18	18
		Subtotals	102	180

Receptors subscore (100 x factor score subtotal/maximum score subtotal) 57

II. WASTE CHARACTERISTICS

A. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity (S = small, M = medium, L = large) S
2. Confidence level (C = confirmed, S = suspected) C
3. Hazard rating (H = high, M = medium, L = low) H

Factor Subscore A (from 20 to 100 based on factor score matrix) 60

B. Apply persistence factor
Factor Subscore A x Persistence Factor = Subscore B

60 x 0.8 = 48

C. Apply physical state multiplier
Subscore B x Physical State Multiplier = Waste Characteristics Subscore

48 x 1.0 = 48

III. PATHWAYS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score

A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points for direct evidence or 80 points for indirect evidence. If direct evidence exists then proceed to C. If no evidence or indirect evidence exists, proceed to B.

Subscore 80

B. Rate the migration potential for 3 potential pathways: Surface water migration, flooding, and groundwater migration. Select the highest rating, and proceed to C.

1. Surface water migration

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
Distance to nearest surface water	3	8	24	24
Net precipitation	3	6	18	18
Surface erosion	1	8	8	24
Surface permeability	1	6	6	18
Rainfall intensity	2	8	16	24
		Subtotals	72	108

Subscore (100 x factor score subtotal/maximum score subtotal) 67

2. Flooding

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
Flooding	1	1	1	3

Subscore (100 x factor score/3) 33

3. Groundwater migration

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
Depth to groundwater	2	8	16	24
Net precipitation	3	6	18	18
Soil permeability	1	8	18	24
Subsurface flows	1	8	8	24
Direct access to groundwater	0	8	0	24
		Subtotals	50	114

Subscore (100 x factor score subtotal/maximum score subtotal) 44

C. Highest pathway subscore

Enter the highest subscore value from A, B-1, B-2 or B-3 above.

Pathways Subscore 80

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors	57
Waste Characteristics	48
Pathways	80

Total 185 divided by 3 = 62 Gross Total Score

B. Apply factor for waste containment from waste management practices

Gross Total Score x Waste Management Practices Factor = Final Score

60 x 1.0 = 62

HAZARDOUS ASSESSMENT RATING FORM

NAME OF SITE Vehicle Maintenance Waste Storage Area, Site No. 3

LOCATION Northeast corner of Bldg. 3646

DATE OF OPERATION OR OCCURRENCE Early 1970s to Present

OWNER/OPERATOR 192nd TFG, Virginia Air National Guard

COMMENTS/DESCRIPTION

SITE RATED BY Science & Technology, Inc.

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
A. Population within 1,000 ft. of site	3	4	12	12
B. Distance to nearest well	3	10	30	30
C. Land use/zoning within 1 mile radius	9	3	9	9
D. Distance to installation boundary	3	6	18	18
E. Critical environments within 1 mile radius of site	0	10	0	30
F. Water quality of nearest surface water body	1	6	6	18
G. Groundwater use of uppermost aquifer	1	9	9	27
H. Population served by surface water supply within 3 miles downstream of site	0	6	0	18
I. Population served by groundwater supply within 3 miles of site	3	6	18	18
Subtotals			102	180

Receptors subscore (100 x factor score subtotal/maximum score subtotal) 57

II. WASTE CHARACTERISTICS

A. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity (S = small, M = medium, L = large) S
2. Confidence level (C = confirmed, S = suspected) C
3. Hazard rating (H = high, M = medium, L = low) M

Factor Subscore A (from 20 to 100 based on factor score matrix) 50

B. Apply persistence factor
Factor Subscore A x Persistence Factor = Subscore B

50 x 0.9 = 45

C. Apply physical state multiplier
Subscore B x Physical State Multiplier = Waste Characteristics Subscore

45 x 1.0 = 45

III. PATHWAYS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score

A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points for direct evidence or 80 points for indirect evidence. If direct evidence exists then proceed to C. If no evidence or indirect evidence exists, proceed to B.

Subscore 80

B. Rate the migration potential for 3 potential pathways: Surface water migration, flooding, and groundwater migration. Select the highest rating, and proceed to C.

1. Surface water migration

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
Distance to nearest surface water	3	8	24	24
Net precipitation	3	6	18	18
Surface erosion	1	8	8	24
Surface permeability	1	6	6	18
Rainfall intensity	2	8	16	24
Subtotals			64	108

Subscore (100 x factor score subtotal/maximum score subtotal) 59

2. Flooding

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
Flooding	1	1	1	3

Subscore (100 x factor score/3) 33

3. Groundwater migration

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
Depth to groundwater	2	8	16	24
Net precipitation	3	6	18	18
Soil permeability	1	8	8	24
Subsurface flows	1	8	8	24
Direct access to groundwater	0	8	0	24
Subtotals			50	114

Subscore (100 x factor score subtotal/maximum score subtotal) 44

C. Highest pathway subscore

Enter the highest subscore value from A, B-1, B-2 or B-3 above.

Pathways Subscore 80

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors	57
Waste Characteristics	45
Pathways	80

Total 161 divided by 3 = 61 Gross Total Score

B. Apply factor for waste containment from waste management practices

Gross Total Score x Waste Management Practices Factor = Final Score

61 x 1.0 = 61

192nd Tactical Fighter Group
Virginia Air National Guard
Byrd International Airport
Sandston, Virginia

USAF Hazard Assessment Rating Methodology
Rating Factor Criteria

The following is a summary and explanation of the HARM factor rating criteria for the three proposed sites at the VaANG Base. The rating factors of the receptors and pathways categories which are identical to each of the three sites, will be stated once. The variation in individual rating factors for each of the four categories will be stated for each individual site.

I. RECEPTORS

A. Population within 1,000 feet of site. Factor Rating 3 - In addition to on base personnel the population, within a 1,000 foot radius of base sites exceed 100 people.

B. Distance to nearest well. Factor Rating 3. Each of the 3 proposed sites is less than 3,000 feet from the most adjacent water well.

C. Land use/zoning (within one mile radius). Factor Rating 3 - Residential housing within a 1 mile radius of base site. The town at Sandston, Virginia has residential housing directly adjoining to the VaANG base boundary.

D. Distance to installation boundary. Factor Rating 3. Each of the 4 sites located within 1,000 feet of the Base boundary.

E. Critical environment within 1 mile radius of site. Factor Rating 0. No critical environments with a 1 mile radius of base.

F. Water quality of nearest surface water body. Factor Rating 1. Streams adjacent to base used for recreation. Streams not used as drinking water source.

G. Groundwater use of uppermost aquifer. Factor Rating 1. The uppermost unconfined aquifer occasionally used for drinking water, agricultural or industrial purposes. The majority of potable water wells produce from the deeper confined Potomac aquifer. Wells in the VaANG base vicinity which produce from the Yorktown aquifer are further than 3,000 feet from the VaANG base boundary.

H. Population served by surface water within 3 miles downstream of site. Factor rating 0 - Population within a 3 mile radius of the VaANG base use municipal water and potable waterwells as a water source.

I. Population served by groundwater supply within 3 miles of site. Factor Rating 3. There are 36 water wells within a 3 mile radius of the VaANG base which supply a municipal and domestic water source.

I. WASTE CHARACTERISTIC

Site No. 1

A.1 Waste Quantity - Factor Rating S (small). The precise amount of waste released is estimated to be 240 gallons over a 6 year period.

A.2 Confidence Level - Factor Rating C. It has been confirmed through research of VaANG base records and interviews with VaANG base personnel that small quantities of waste were released.

A.3 Hazard Rating - Factor Rating H. Sax toxicity rating of 3 which corresponds to a HARM toxicity of 3.

Site No. 2

A-1 Waste Quantity - Factor Rating S. One to four drums are used as storage for contaminated JP-4 fuel.

A-2 Confidence Level - Factor Level C. Visible on site observation observed bowser storage drums leaking small volumes of contaminated JP-4. No reports of a major spill were observed in base records search.

A-3 Hazard Rating - Factor Rating H. This score based upon JP-4 hich has a Sax toxicity rating of 3. This corresponds to a HARM hazard rating of 3.

Site No. 3

A-1 Waste Quantity - Factor Rating S. Visible site observations observed four to six 55 gallon drums used for storing vehicle maintenance waste.

A-2 Confidence Level- Factor Rating C. It was confirmed by visible on site observation that small quantities of waste were released from the vehicle maintenance waste drum holding area.

A-3 Hazard Rating - Factor Rating M. The Sax toxicity rating level for petroleum products, i.e., hydraulic oil, motor oil, etc., is 2 which corresponds to a medium HARM hazard rating.

B. <u>Persistence Multiplier</u>

Site No. 1 = 1   Site No. 4 = 0.9   Site Nos. 2&3 = 0.8

The persistence multiplier of 1.0 for site No. 1 based on Trichloroethylene which falls into the HARM category of metals polycyclic compounds and halogenated compounds. Site No. 2 was assigned a persistence multiplier of 0.9 because of the presence of JP-4 JP-4 is assigned the HARM category of "substituted and other ring compounds." Sites No. 3 was assigned a 0.8 persistence multiplier because waste motor and hydraulic oil are assigned the HARM category of "straight chain hydrocarbons."

C. <u>Physical State Multiplier</u>

Site Nos. 1-4 = 1.0

The waste substances released at sites 1-3 were liquids. Therefore, the physical state multiplier for each site is 1.0.

III. <u>PATHWAYS CATEGORY</u>

A. <u>Evidence of Contamination</u>

<u>Site No. 1</u>: No Evidence - Factor Rating 0.

<u>Site No. 2</u>: Indirect Evidence - Factor Rating 80. Visible evidence of contaminated JP-4 move to next page top leaking from the Bowser holding drums is the indirect evidence of contamination. No other contaminated JP-4 sources adjacent to Site No. 3.

<u>Site No. 3</u>: Indirect Evidence Factor Rating 80. Obvious visible waste oil leaking from vehicle maintenance waste oil holding drums. Obvious waste oil observed on ground surface and oil odor and soil sample directly adjacent to drum holding area.

B.1 <u>Potential for Surface Water Contamination</u>

- <u>Distance to nearest surface water</u>: Factor Rating 2 for Site No. 1. Site No. 1 is further than 500 feet from any surface water, i.e., stream, storm sewer or drainage ditch. Factor Rating 3 for sites 2 and 3. Sites 2 and 3 are closer than 500 feet from any surface water, i.e., surface streams, drainage ditches, storm sewer, etc.

- o Net precipitation; Factor rating 3. The net precipitation at the base averages approximately 33 inches of rain and snow/year.
- o Soil erosion; Factor Rating 1. Gentle topographic slopes at the Base of 0.20 prevent rapid surface water runoff and excess soil erosion.
- o Soil permeability; Factor Rating 1. Permeability rates for soil at base are estimated by USDA soil conservation service between 10^{-2} and 10^{-4} cm/sec.
- o Rainfall intensity based on 1 year, 24 hour rainfall; Factor Rating 2. The 1 year, 24 hour rainfall varies between 2.1 and 3.0 inches.

B.2 Potential for Flooding - Factor Rating 1. The Base is located within a 100 year cyclic flood plain.

B.3 Potential for Contaminated Groundwater

- o Depth to groundwater; Factor Rating 2. Normal soil watertable depth at the Base is 15 feet during fair weather conditions. An increase in precipitation will result in a shallower water table.
- o Net precipitation: Factor Rating 3. See B-1
- o Soil permeability: Factor Rating 1. See B-1
- o Subsurface flows

  Sites 1, 2 and 3: Factor Rating 1. Sites 1,3 and 4 are sites where wastes have been released on the ground surface. With the shallowest yearly watertable at 1 1/2 feet from ground surface, it is unlikely that the released contaminants are periodically below the watertable.

- o Direct access to groundwater (through faults, fracture faulty well casing, subsidence, fissures, etc.)

  Site No. 1: Factor Rating 0

  Site No. 2: Factor Rating 0.

  Site No. 3: Factor Rating 0.

IV. WASTE MANAGEMENT PRACTICES FACTOR MULTIPLIER

Site Nos. 1-3 = 1.0. None of the Base sites has any form or type of contaminant containment.

Appendix E

VaANG Underground Storage Tanks (USTs)

TABLE IVC-2. LIST OF UNDERGROUND STORAGE TANKS, SITE NO. 2

Tank ID. No. (Location)	Status	Date Installed	Capacity Gallons	Tank Construction	Associated Contents
27	Abandoned	Unknown	25,000	Steel	Unknown
28	Abandoned	Unknown	25,000	Steel	Unknown
29	Abandoned	Unknown	25,000	Steel	Unknown
30	Abandoned	Unknown	25,000	Steel	Unknown
31	Abandoned	Unknown	25,000	Steel	Unknown
32	Abandoned	Unknown	25,000	Steel	Unknown
33	Abandoned	Unknown	25,000	Steel	Unknown
34	Abandoned	Unknown	25,000	Steel	Unknown
35	Abandoned	Unknown	2,000	Steel	Unknown
36	Abandoned	Unknown	2,000	Steel	Unknown
37	Abandoned	Unknown	2,000	Steel	Unknown
38	Abandoned	Unknown	2,000	Steel	Unknown

VaANG BASE UNDERGROUND STORAGE TANKS

Tank ID No. (Location)	Status	Date Installed	Capacity Gallons	Tank Construction	Contents	Associated Building
TK-1	Active	1943	25,000	Steel Epoxy Lined	JP-4	3635 Fuels Management
TK-2	Active	1943	25,000	Steel Epoxy Lined	JP-4	3635 Fuels Management
TK-3	Active	1943	25,000	Steel Epoxy Lined	JP-4	3635 Fuels Management
TK-4	Active	1943	25,000	Steel Epoxy Lined	JP-4	2635 Fuels Management
TK-7	Active	1979	5,000	Steel	Diesel Fuel	2855 Motor Pool
TK-8	Active	1963	5,000	Steel	Unleaded Gas	2855 Motor Pool
TK-9	Active	1983	550	Steel	Leaded Gas	2855 Motor Pool
TK-10	Active	1960	1,000	Steel	JP-4	2849 AGE
TK-11	Active	1960	1,000	Steel	Diesel Fuel	2849 AGE
TK-14	Active	1977	400	Steel	Detergent	2851 Corrosion Control
TK-15	Active	1977	300	Steel	Waste Oil	2851 Corrosion Control
TK-21	Active	1943	25,000	Steel	Waste JP-4	3635 Fuels Management
TK-22	Deactivated as of 1959	1943	25,000	Steel	Filled With Water	3635 Fuels Management
TK-23	Deactivated as of 1959	1943	25,000	Steel	Filled With Water	3635 Fuels Management
TK-24	Deactivated as of 1959	1943	25,000	Steel	Filled With Water	3635 Fuels Management
TK-25	Active	1965	2,000	Steel	Diesel Fuel	3905 Gate House Munitions Storage
TK-26	Out of Service Since 1980	1963	5,000	Steel	Empty Last Stored Detergent	3662 Wash Rack Pump House

VaANG BASE UNDERGROUND STORAGE TANKS

Tank ID No. (Location)	Status	Date Installed	Capacity Gallons	Tank Construction	Contents	Assocaited Building
2749-1	Active	1962	1,000	Steel	Fuel Oil	2749 Barracks Building
2849-1	Active	1960	1,500	Steel	Fuel Oil	2849 AGE Maintenance
3629-1	Active	1983	2,000	Steel	Fuel Oil	3629-Base C.E.
3630-1	Active	1943	2,000	Steel	Fuel Oil	3630 Base Club/ ST HQ
3633-1	Active	1983	3,000	Steel	Fuel Oil	3633 Weapons Release
3648-1	Active	1974	1,000	Steel	Fuel Oil	3648 Jet Engine Shop
3649-1	Active	1958	10,000	Steel	Fuel Oil	3649 Hangar
3652-1	Active	1966	3,000	Steel	Fuel Oil	3652 Res. Forces OPL TNG/O & T
3656-1	Active	1981	2,000	Steel	Fuel Oil	3656 Avionics Shop
3660-1	Active	1969	550	Steel	Fuel Oil	3660 Missile Maint.
3661-1	Active	1978	4,000	Steel	Fuel Oil	3661 SQ OPS
3905-1	Active	1965	2,000	Steel	Fuel Oil	3905 Munitions
3906-1	Active	1965	550	Steel	Fuel Oil	3906 Munitions
2851-1	Active	1977	2,000	Steel	Fuel Oil	2851 Corrosion Control
3154-1	Active	1985	2,000	Steel	Fuel Oil	3654 Med/Din Facility

Notes: (1) Tanks 22, 23, and 24 were last used in 1955. (2) All steel tanks probably have bitumen (asphaltic) external coating. (3) Tanks used to store heating oil for consumptive use on the premises as well as traps are not regulated. These tank numbers were assigned to reference their respective building numbers.